

U. S. DEPARTMENT OF AGRICULTURE,

BUREAU OF SOILS—MILTON WHITNEY, Chief.

IN COOPERATION WITH THE TEXAS AGRICULTURAL EXPERIMENT STATION,
B. YOUNGBLOOD, DIRECTOR.

SOIL SURVEY OF FREESTONE COUNTY, TEXAS.

BY

H. W. HAWKER, IN CHARGE, AND F. A. HAYES, OF THE U. S.
DEPARTMENT OF AGRICULTURE, AND J. F. STROUD AND
NEAL GEARREALD, OF THE TEXAS AGRICULTURAL
EXPERIMENT STATION.

HUGH H. BENNETT, INSPECTOR, SOUTHERN DIVISION.

[Advance Sheets—Field Operations of the Bureau of Soils, 1918.]



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LETTER OF TRANSMITTAL.

U. S. DEPARTMENT OF AGRICULTURE,

BUREAU OF SOILS,

Washington, D. C., October 20, 1920.

SIR: I have the honor to transmit herewith the manuscript report and map covering the soil survey of Freestone County, Texas., and to recommend that they be published as advance sheets of Field Operations of the Bureau of Soils, 1918, as authorized by law. This work was done in cooperation with the Texas Agricultural Experiment Station, B. Youngblood, director.

Respectfully,

MILTON WHITNEY,

Chief of Bureau.

Hon. E. T. MEREDITH,

Secretary of Agriculture.

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SOIL SURVEY OF FREESTONE COUNTY, TEXAS.

By H. W. HAWKER, In Charge, and F. A. HAYES, of the United States Department of Agriculture, and J. F. STROUD and NEAL GEARREALD, of the Texas Agricultural Experiment Station.—Area Inspected by HUGH. H. BENNETT.

DESCRIPTION OF THE AREA.

Freestone County is situated in east-central Texas, about 115 miles from the Louisiana State line. Teague, the principal city, is about 85 miles south of Dallas, 50 miles east of Waco, and 130 miles north of Houston. Freestone County is bounded on the southeast and south by Leon County, and the southwest and west by Limestone County, on the northwest and north by Navarro County, and on the northeast and east by the Trinity River, which separates it from Anderson County. The county contains 871 square miles, or 557,440 acres.

By far the greater part of Freestone County consists of Coastal Plain upland. The topography in general is that of a smooth, even plain, with a gentle slope from the north and west to the east and



FIG. 1.—Sketch map showing location of the Freestone County area, Texas.

south. In detail, however, this plain is well dissected, owing to the erosion to which it has been subjected since its emergence from the waters which in prehistoric time covered it. The smoothest areas seem to occur in that part of the prairie situated well away from Tehuacana Creek, in the western part of the county. In the eastern part erosion has been more severe, and the topography is hilly and sloping. North and east of Turlington and east of Dew are several small hills, whose prominent elevation above the level of the immediately surrounding country is due to the resistance with which the material of which they are formed has met weathering and erosion.

Pilot Knob, Burleson Hill, Fulgium Hill, and West Point Hill are the most prominent of the higher elevations.

About the heads of the streams and along their upper courses the slopes are steepest and extremes of elevation greatest. Here the banks are steep and sharply cut, forming gullies which are locally termed "dugouts." Further downstream the topography becomes rolling and the descent from the upland to the stream bottoms is gradual. The upland between the larger streams, such as Tehuacana, Richland, and Keechi Creeks and Trinity River, may be generally described as ranging from flat to gently rolling, becoming rolling to hilly along the streams.

The upland is timbered, with the exception of about 50 square miles in the western and northwestern parts of the county, a small area at the northern point of the county, and small prairie areas scattered about over its entire area. It is reported that the prairie area has been encroached upon considerably by forest during the last 50 years.

In the sandy regions there occur numerous sinklike depressions, having a generally flat surface. They lie mainly along drainage ways, but some occur between ridges and have no drainage outlets. Some of these depressions are of considerable size. While their origin may be due to stream erosion or wind action, or both, the present surface material is mainly colluvial wash from the adjoining slopes, with some alluvial addition adjacent to the drainage ways, where streams are present.

The bottom lands of the Trinity River, the largest stream in the county, are mainly level, but slope slightly toward the channel and in the direction of the stream flow. The wider bottoms are interrupted in places by sloughs and remnants of old channels, and by streams which enter them from the upland. Only a small proportion of the Trinity River bottom land is under cultivation, owing mainly to the overflows but in part to the difficulty of clearing. The proportion of alluvial lands under cultivation along the smaller streams is considerably larger. The bottom lands along Tehuacana, Keechi, and Richland Creeks vary in width from about one-eighth mile to $1\frac{1}{2}$ miles; those along the Trinity, on the west side of the river, are more than 3 miles wide in places.

Along the Trinity River and the larger creeks are found terrace or second-bottom remnants, which are never continuous and generally small in extent. The largest area of old alluvial or second-bottom material occurs between Oakwood and the river, and, though it appears to continue for some distance southward, little of it occurs within Freestone County. These terrace areas are situated well above present overflow. They were originally timbered, but are at present largely under cultivation.

The first bottoms are subject to periodic overflows except immediately adjacent to the upland, where narrow strips have received sufficient colluvial accumulations of soil from the upland to raise their level, or where the sediments were deposited in a position above normal overflow. Backwater from the Trinity River keeps the bottom lands of the creeks near their mouths inundated for fairly long periods at a time.

Traveling from west to east in Freestone County, a considerable transition in the timber growth is observable. In the western half of the county post oak and blackjack oak are predominant, supplemented by hickory and elm and some bur and red oak. Along the streams and in the stream bottoms water oak predominates, with some elm and willow. Here also in some places there are sycamore, cedar, and locust, mainly on the upland. Farther east pin oak, black oak, and red oak become more numerous, and there are thick growths of turkey oak ("sand jack") in the sandy areas. Pecan, walnut, sweet gum, black gum, tupelo gum, prickly ash, dogwood, and ironwood are also common, and hackberry, birch, poplar, cottonwood, holly, and myrtle abound in places. Persimmon and wild plum are often seen in old fields. Adjacent to the Trinity River bottoms there are a few areas of loblolly pine. "French mulberry," pokeweed, sumac, scrub oak, smilax vines, and several large weeds comprise the principal undergrowth. Buckbrush is present in some parts of the county. In the prairie areas mesquite was the only tree growth. It is still found along stream slopes, sometimes interspersed with stunted elm.

Elevations in this county range between 200 and 600 feet, the former being the approximate level of the Trinity River bottoms at the southeast county line. The Trinity & Brazos Valley Railway reports the following elevations along its right of way: Donie, 495 feet; Freestone, 511 feet; Teague, 500 feet; Simsboro, 540 feet; Kirvin, 472 feet; Streetman, 377 feet; crossing at southeast county line, 488 feet; at northwest county line, 380 feet; at southwest county line, 525 feet; 320 feet in Tehuacana Creek bottoms. The Houston & Texas Central Railway reports an elevation of 472 feet at Wortham, 442 feet where its line crosses the northwest county line, 454 feet on the southwest county line, and 425 feet in the Wolf Creek bottoms. The International & Great Northern Railway reports an elevation of 388 feet at Buffalo (just south of the county line), 230 feet at Oakwood, and 215 feet in the Trinity River bottoms.

The Trinity River receives the drainage waters from all of Freestone County except a small area in the southwest portion, whose run-off finds its way into the Navasota River. The Trinity drains directly only a narrow strip immediately adjacent to it. The greater part of the drainage of the county finds its way into Tehuacana

Creek, a considerable portion into Keechi Creek, and the balance into Buffalo and Richland Creeks. Teague is situated on the divide between the drainage flowing north and south and east and west. The divide between the drainage flowing northward into Tehuacana Creek and south into Navasota River and Keechi Creek is followed roughly by the Mexia-Teague, Teague-Fairfield, and Fairfield-Oakwood roads. Branches of the stream reach into all sections of the county and provide adequate drainage for by far the greater part. The streams of the county are all intermittent, with the exception of the Trinity River. In the deep sandy areas springs are quite common, but these also may become dry in excessively droughty seasons.

The drainage of this region may be described as young, since the streams are still engaged in deepening their channels. Erosion is constantly taking place in the form of washing of stream slopes and the cutting back of the "dugouts." In cultivated areas these gullies have been known to cut back 100 feet or more during a single heavy rain.

The first recorded settlement in Freestone County was made in 1834, on the west side of the Trinity River near what is now known as West Point Hill. From this place trading was carried on with the Comanche, Waco, Tehuacana, and Keechi Indians, who occupied the territory immediately west of the river. Surveys were made west of the river as early as 1832 and 1833. The country near the Trinity was soon settled, the State of Coahuila and Texas having made inducements for occupation and settlement, and Spanish grants, previously made, were surveyed and opened for settlement. From 1836 until 1844 there was trouble with the Indians, and it was not until 1846 that settlements were extended to other points along the Trinity and towns established at the present sites of Simsboro and Cotton Gin. The village of Cotton Gin was established in 1849, Butler in 1850, and Fairfield, then known as Mount Pleasant, in the same year. A great influx of settlers took place in 1850 and 1851, when large planters came into the county from the more densely populated States to the east and northeast.

Before the construction of the railways the Trinity River was the chief means of transportation. Farm products were freighted to Houston, the principal market, and needed commodities were brought back by boats and barges. Overland traffic was by means of ox teams and heavy wagons, and large quantities of cotton were taken to Houston in this way. West Point Hill was about the farthest upstream point reached by boats, and it could be reached only during high water.¹

¹ "A Memorial and Biographical History of Navarro, Henderson, Anderson, Limestone, Freestone and Leon Counties, Texas," by the Lewis Publishing Co., of Chicago, is the source of much of the early history of the county contained in this report.

The population of the county increased from 6,881 in 1860 to 14,921 in 1880, 20,497 in 1910, and 23,264 in 1920. In the latter year 85.8 per cent of the population was classed as rural. The proportion of foreign-born persons is less than 1 per cent. About 40 per cent of the population is colored.

Teague, the largest town and the principal trading point in the county, was established about 1906. Its population in 1920 amounted to 3,306. In the same year Wortham had a population of 1,100, and Oakwood, which lies partly in Leon County, had a population of 1,100. Fairfield, the county seat, is centrally located. Streetman, Kirvin, Simsboro, Freestone, and Donie are local trading points. Most of the villages have one or more cotton gins, and others are scattered throughout the county. Teague has, in addition, a compress and cottonseed oil mill.

The educational facilities of the larger towns are first class, and many of the rural communities also have good schools. Telephone service is maintained throughout the country and rural mail delivery routes reach all sections. Sand-clay roads have been constructed between some of the principal towns, but the highways are not well kept up at present.¹

The Trinity & Brazos Valley Railroad provides transportation facilities for the greater part of the county. Three divisions converge at Teague—the Cleburne division, from Cleburne to Teague; the Teague division, from Teague to Houston; and the Dallas division, from Teague to Waxahachie and Dallas. The Houston & Texas Central Railway crosses the western corner of the county, and the International & Great Northern Railway cuts through the eastern corner, roughly paralleling the southeastern boundary for a considerable distance. The lack of railway facilities accounts in large measure for the retarded development of the northeastern part of the county. Until the low level of water in the Trinity River made it impossible, boats came upstream from Houston, transporting the products of the farmers adjacent to the river to that market.

Houston and Dallas are the chief markets for all the farm products of the county, except live stock, which is shipped chiefly to Fort Worth.

CLIMATE.

No Weather Bureau station is maintained in Freestone County, the nearest stations being those at Palestine, in Anderson County, to the east, and at Corsicana, in Navarro County, to the north. The data show a range in temperature from 7° F. below zero to 113° F. The mean temperature is approximately 66° F. Warm weather com-

¹At the time of going to press, an extensive system of gravel surfaced roads is under construction in parts of the county.

mences in March and continues until the end of October. The period from November to February is generally not unpleasant, except for the sudden drops of temperature, locally termed "northers," in which the mercury often falls 30° or more in a few hours. Pronounced extremes of temperature occur only during these northerns or in the cold snaps immediately following, and a normal temperature is resumed within 24 to 72 hours after their occurrence. The drops in temperature may be accompanied by cold rains, and occasionally by light snows, the latter being very rare, however. The winter temperature is frequently low enough to damage or freeze out winter crops, such as oats and wheat, where not well protected. The summer heat is moderated to a large extent by the Gulf breeze, though occasionally it is increased by hot, dry northerly winds. These are greatly disliked, since they draw largely upon the already meager supply of soil moisture and sap the strength of growing crops. The mean temperature for the summer months ranges from 80° to 85°.

Conditions at Palestine as regards elevation and vegetation are representative of the greater part of Freestone County, while conditions in the territory contiguous to Corsicana are similar to those in the prairie area extending from Streetman to Wortham and beyond. As a result the precipitation records from the stations at Palestine and Corsicana should closely represent conditions in the timbered and prairie parts of Freestone County, respectively, bearing in mind, however, a gradual decrease in precipitation from the Trinity River westward in central Texas.

The mean annual precipitation at Palestine is 43.14 inches, with a maximum of 61.19 inches in 1892, the wettest year on record, and a minimum of 23.98 inches in 1909, the driest year recorded. The records at this station show an average of 2.3 inches of snow annually. The records of the Corsicana station show an annual mean precipitation of 35.98 inches for a period of 28 years, a maximum of 49.47 inches in 1905, and a minimum of 23.49 inches in 1901. The rainfall is heaviest during the spring or planting months and lightest during the summer months. The summers are apt to be droughty and the summer seasons of 1916, 1917, and 1918 were dry enough to decrease crop yields. Corn on some soils was a complete failure during these years. Where there is sufficient rain during the spring months thorough cultivation generally insures an adequate supply of moisture, but occasionally the summer supply of moisture, plus that stored in the soil, is below the actual needs of vegetable life. The dry fall weather makes possible the efficient harvesting of crops.

The records at Corsicana and Palestine give the average date of the last killing frost in the spring as March 15 and 13, respectively, and that of the first killing frost in the fall as November 13. This gives an average growing season of 244 days, which is more than

sufficient for the needs of all the crops grown. Under boll-weevil conditions cotton is frequently planted before the middle of March, but the chance of killing by frost in the timbered upland is believed to be almost negligible. The records at Palestine show that a killing frost has occurred as late as March 30, while the earliest known killing frost in the fall is reported on October 20. During the 28 years in which records have been kept at Corsicana the latest killing frost in the spring occurred on May 1 and the earliest in the fall on October 22. It is considered unsafe to plant as early on the prairie soils as on the uplands protected by the proximity of timber. Spring frosts are likely to occur on the bottom lands after all danger of frost on the uplands is over and the bottom lands are apt to receive an earlier frost in the fall.

The tables below show the normal monthly, seasonal, and annual temperature and precipitation as recorded by the Weather Bureau stations at Palestine, Anderson County, and Corsicana, Navarro County:

Normal monthly, seasonal, and annual temperature and precipitation at Palestine, Anderson County.

(Elevation, 510 feet.)

Month.	Temperature.			Precipitation.			Snow, average depth.
	Mean	Absolute maximum.	Absolute minimum	Mean.	Total amount for the driest year. (1909).	Total amount for the wettest year. (1892).	
December.....	°F.	°F.	°F.	Inches.	Inches.	Inches.	Inches.
	49.4	81	8	3.67	2.40	11.04	0.6
January.....	46.5	84	0	3.87	.19	3.93	.9
February.....	51.0	83	-6	3.51	3.56	5.05	.7
Winter.....	49.0	84	-6	11.05	6.15	20.02	2.2
March.....	58.5	90	20	3.47	2.27	4.70	.1
April.....	65.9	92	34	4.08	2.51	4.80	.0
May.....	72.5	96	39	4.89	.98	4.18	.0
Spring.....	65.6	96	20	12.44	5.76	13.68	.1
June.....	78.4	100	48	4.00	3.36	9.77	.0
July.....	81.5	103	60	3.00	.80	1.60	.0
August.....	80.5	108	54	2.22	2.11	3.41	.0
Summer.....	80.1	108	48	9.22	6.27	14.78	.0
September.....	74.7	104	43	3.20	1.55	.98	.0
October.....	66.2	97	31	3.60	2.74	5.74	.0
November.....	56.9	87	20	3.63	1.51	5.99	T.
Fall.....	65.9	104	20	10.43	5.80	12.71	T.
Year.....	65.2	108	-6	43.14	23.98	61.19	2.3

Normal monthly, seasonal, and annual temperature and precipitation at Corsicana, Navarro County.

(Elevation, 445 feet.)

Month.	Temperature.			Precipitation.		
	Mean.	Absolute maximum.	Absolute minimum.	Mean.	Total amount for the driest year (1901).	Total amount for the wettest year (1905).
December.....	°F. 48.4	°F. 82	°F. 8	Inches. 3.27	Inches. 1.06	Inches. 4.77
January.....	47.1	88	5	2.34	.28	1.94
February.....	49.4	85	-7	2.55	2.63	3.19
Winter.....	48.3	88	-7	8.16	3.97	9.90
March.....	58.3	95	18	2.80	2.93	4.31
April.....	66.6	96	31	3.72	1.14	6.90
May.....	73.6	98	31	5.08	5.41	5.32
Spring.....	66.2	98	18	11.60	9.48	16.53
June.....	80.6	107	41	3.25	.15	4.55
July.....	84.0	113	54	2.58	.51	6.56
August.....	83.5	112	50	1.93	1.01	1.53
Summer.....	82.7	113	41	7.76	1.67	12.64
September.....	77.4	104	42	2.72	4.02	2.80
October.....	67.0	98	32	2.70	1.58	4.19
November.....	56.0	88	18	3.04	2.77	3.41
Fall.....	66.8	104	18	8.46	8.37	10.40
Year.....	66.0	113	-7	35.98	23.49	49.47

AGRICULTURE.

Agricultural development in this region was encouraged first by the Spanish Crown, then by the Mexican National Government, the State of Coahuila and Texas, and by the Republic of Texas after its organization. The farm practices were largely influenced by those in the regions from which the early settlers migrated, with minor adjustments due to the climatic differences. The methods of cultivation were largely the same, without due regard to the conditions of rainfall, soil, and temperature, and this early influence may be seen even now in the less progressive sections of the county.

Cotton has always been the chief crop, followed by corn, which is grown for subsistence rather than for market. Some oats and wheat were grown in the early days, and gardens were everywhere in evidence. Statistics available show a production of 6,913 bales of cotton in 1859. For 1869 the crop was 6,465 bales, the decrease being due to the release of slave labor following the Civil War.

Cotton was marketed at Houston either by means of barges and boats on the Trinity River or by overland hauling for a distance of 150 miles or more.

The high percentage of heavily timbered land and of areas unsuitable for agriculture, together with the ease with which cattle and hogs could be raised, caused stock raising to occupy a rather important place in the early development of the county.

Census statistics show that until very recently the acreage of cotton and corn steadily increased, while that of the other grain and feed crops has suffered a decline. Cotton has increased twice as fast as corn. The development of railway facilities and the consequent establishment of nearer markets account for the increase from 1869 to 1879, in which years the production of cotton was 6,465 and 8,182 bales, respectively. A considerable increase in acreage and the development of a better agriculture were coincident with the growth in population between 1880 and 1900 and resulted in a large gain in production. The cotton production increased to 15,816 bales from 49,349 acres in 1889 and 22,695 bales from 72,694 acres in 1899, while corn showed an increase from 252,742 bushels from 29,242 acres in 1879 to 765,630 bushels from 48,072 acres in 1899. Oats almost doubled in acreage from 1879, when they were grown on 1,462 acres, to 1899, when they occupied 2,662 acres.

In 1909, according to the census, cotton occupied about 60 per cent of the cultivated area of the county. Both cotton and corn, however, showed a decrease in acreage from that of 1899, the area devoted to corn falling to 42,115 acres, and that in cotton to 66,101 acres. The abandonment of over 12,000 acres of agricultural land is ascribed to the advent of the boll weevil, and the "turning out" of land whose productiveness had decreased to an unprofitable point as a result of continuous cropping to clean-cultivated crops without diversification or fallowing.

War conditions existing at the present time and the efforts of the county demonstration force² have resulted in a form of agriculture in which cotton is still the most important crop, but in which the county is more nearly self-supporting from a subsistence standpoint. A large expansion is taking place in the acreage of corn, oats, wheat, peanuts, and cowpeas, attended by some decrease in the cotton acreage. Cowpeas and peanuts are being grown extensively as soil-improving crops. There has also been an increase in the number of live stock raised, and a tendency toward the improvement of the quality.

² The authors are indebted to Messrs. Davis and Richardson of the Freestone County Demonstration Force for some of the agricultural data used in this chapter. Statements as to cultural and fertilizer methods and crop yields are based on interviews with farmers.

Mebane and Lone Star are the two most popular varieties of cotton in this county. A number of other varieties are also grown, including Big-Boll Rowden. Cultural methods vary somewhat, but the most progressive farmers flat break the land in October or November. It is generally left rough until January or February, when it is gone over with a section or disk harrow. Sometimes the land is bedded immediately after breaking, in which event the beds are torn down at the time of harrowing. About the 1st of March, or slightly earlier, a middle buster is used to bed, and a drag is used to prepare the seed bed. Farmers who fertilize generally scatter the fertilizer in the middles about 10 days to 2 weeks before planting. The beds are then thrown over the middles and redragged. Planting follows in rows 3 to 4 feet apart. The first cultivation is given 10 days to 2 weeks after planting, a harrow generally being used. The second cultivation is made with a cultivator having four sweeps, and chopping follows about one week later. Five cultivations are generally given cotton, 12-inch sweeps being used in the last two cultivations. Fertilizer practices vary somewhat, depending on the soil. Prairie lands or new fields are seldom fertilized for cotton. A fertilizer analyzing 10-1.65-0³ is used on old fields at present, the lack of potash being due to war conditions. A fertilizer made up of 16 per cent phosphoric acid and cottonseed meal, mixed in the ratio of 2 to 1, is often used, in amounts ranging from 150 to 300 pounds per acre.

Cotton is planted earlier since the advent of the boll weevil in an effort to mature the crop earlier and prevent as much damage as possible. From March 1 to 10 is probably the earliest date, though it may be successfully planted as late as June 1 under favorable conditions. Picking begins in August and continues throughout the fall season. Cotton gins are located in almost all the settlements and towns. The ordinary yield of cotton for the county varies from one-fifth to one-half bale per acre. Droughty conditions sometimes reduce the yield.

The corn crop provides the greater part of the feed stuff consumed in the county, but the quantity produced has been insufficient to meet the local needs. Of the known varieties Ferguson Yellow Dent is probably the most popular, and it is the variety used in the boys' corn club work under the direction of the county demonstration force. Some Bloody Butcher and Chisholm are planted. Much of the corn has been grown in this region for so long a time and has suffered crossing so often that it has lost its original identity. In growing corn most of the farmers flat break the land early in the spring, and harrow the same as for cotton. The ground is generally dragged, this being done slightly earlier than for cotton. Just before planting

³Ten per cent phosphoric acid, 1.65 per cent nitrogen, and 0 potash.

time a furrow 3 or 4 inches deep is opened with a 10-inch sweep. The furrows are placed 3 to 4 feet apart. Seed is planted in the furrows, generally 18 to 24 inches apart. A harrow is used for the first and second cultivations to fill in the furrow and level the surface. Ten-inch sweeps are used in the third cultivation and 12-inch sweeps in the fourth and subsequent cultivations. Planting is generally done about March 1, but some farmers plant slightly earlier. In the bottom lands planting is done as late as May 15. Corn is generally not fertilized, especially where this crop follows cotton which has been fertilized the year before. Where fertilizers are used the amount varies from 100 to 200 pounds per acre, and the material is applied just before planting.

A practice which is becoming popular is to plant cowpeas in corn. They may be seeded in alternate rows with the corn, or the alternate second or third rows may be devoted exclusively to cowpeas. In the latter case the cowpeas are sown generally about May 15.

Fodder is obtained by topping during July and August. The fodder is bound in bundles and stacked or stored for winter use. Maturity depends upon the time of planting, the upland corn generally being ready for harvest by the 1st of August or shortly thereafter. Corn on the bottom lands is frequently not ready for harvest before the middle of September. The ears are pulled unhusked to afford protection against the corn weevil.

During the last three seasons corn has suffered as a result of abnormally long droughty seasons. It is necessary in dry periods to keep up constant cultivation to conserve a maximum of moisture for plant needs, and the number of cultivations generally given is insufficient for this purpose. The prevailing method of using a turn plow, following the last cultivation, to turn a slight ridge about the stalks, may actually be harmful, since it disturbs the plant roots and leaves them exposed to the heat of the sun, and also permits the loss of moisture. The custom of planting cowpeas is very beneficial in adding nitrogen and organic matter to the soil, and subsequent yields are invariably increased. Seed selection should be practiced to a larger extent than seems to be done at present. Yields of corn vary with the soil and the nature of the season, and range from about 10 to 35 bushels per acre. The average yield for the county is probably 10 to 20 bushels or more. A yield of $64\frac{1}{2}$ bushels per acre has been obtained by a boys' corn club worker.

Oats rank next to corn in importance. The greater part of this crop is cut green and fed in the sheaf. Where it is to be thrashed the crop is seeded mainly in the spring. A considerable acreage is grown for spring pasture, being sowed in the fall months, mainly October or November. The winter is rarely severe enough to seriously injure fall-seeded oats. The average yield of oats for the

county varies from 10 to $22\frac{1}{2}$ bushels. Average yields of 35 bushels or more are reported for the prairie sections of the county, where the crop is generally grown for thrashing. Texas Red Rustproof is the leading variety, but some unknown varieties of white oats are also grown. The total production of oats is insufficient for the needs of the county.

Owing to the popular belief that this region is not adapted to wheat, this crop has been grown on a very small acreage. A larger acreage is reported in 1879 than at any subsequent census period, but only 151 acres were seeded in that year. Wheat production in Freestone County has been stimulated by the war demands, and a considerable acreage was seeded during the season of 1918, largely in the prairie section of the county. It is proposed to increase the acreage still further in 1919. Fall seeding seems to produce the best results, and no particular damage is caused by the cold weather. Spring seeding is practiced by some farmers. Yields of wheat range from 10 to 20 bushels or slightly more, and the average for the county is probably about 14 bushels. Mediterranean Red is the most popular variety, though considerable Nicaraugua wheat is grown. No fertilizers are used at present for this crop.

A small acreage of peanuts was grown in Freestone County as early as 1889, and the area in this crop has steadily increased since that time. The census reports 775 acres devoted to this crop in 1909, from which 11,675 bushels were produced. Of late years greater attention has been given to peanut production and the acreage and yields have been much increased. White Spanish is the chief variety grown, but a few farmers grow Virginia peanuts. Cultural methods vary with soil conditions and individual preference, and the crop may be planted either on ridges, flats, or in furrows. Four cultivations are generally given, clean cultivation being essential. Up to the present time very little of the crop has been thrashed, the common method being to pull the vines with the peanuts attached and to stack them in small "cocks" or place them loose in barns. They are sometimes harvested by means of 18-inch sweeps attached to a planter, which clip the roots just below the nuts. In this way the nitrogen nodules are permitted to remain in the ground. The hay, with nuts attached, is frequently baled for feeding purposes. From 1 to $1\frac{1}{2}$ tons of hay per acre is obtained by baling the vines and nuts together, and this hay commands a good price.

Cowpeas are often grown in fields by themselves. They may be seeded following the removal of oats or wheat without danger of failing to mature. As a soil improver, through the addition of nitrogen and organic matter, cowpeas are the best crop adapted to Freestone County. The Whippoorwill variety is grown almost exclusively. Where thrashed the crop yields from 15 to 25 bushels per

acre, and where it is cut for hay from 1 to $1\frac{1}{2}$ tons per acre. Where it is planted in alternate rows with corn the yield varies from one-third to one-fourth of that given above. A common practice is to pick some of the peas by hand, after which the vines are cut and baled with the seed left thereon.

Velvet beans have been introduced into the county only recently, and reports vary as to their adaptation. The droughty seasons recently have not permitted a fair trial of the crop, which has been found well adapted to similar soils in other portions of the South. The concensus of opinion is that velvet beans do best on the light bottom lands and that they are surpassed by cowpeas on the uplands.

A small acreage is devoted to feterita, milo, and kafir, which are grown mainly in an experimental way. In a good season yields average about 25 bushels per acre. Under droughty conditions these crops can apparently be grown with better success than corn on a majority of the Freestone County soils, and their acreage should be increased especially in the prairie sections of the county.

Bermuda grass is the chief pasture grass, and it is also cut for hay where it makes sufficient growth on the glades and stream slopes and bottoms. Since open pasturage is available the year round, very little hay is cut. A good stand of Bermuda grass hay yields 1 to $1\frac{1}{2}$ tons per season, in two cuttings, and fall and winter pasturage in addition. Some Johnson grass is grown in this county, mostly on the bottom lands. As elsewhere, difficulty is experienced in eradicating this grass, and where it occurs in cultivated fields it spreads rapidly. As a hay crop it yields three or four cuttings a season and a total of 3 to 5 tons per acre. A little prairie hay is cut in the glades and on the prairie areas. Two cuttings are generally obtained, totaling about $1\frac{1}{2}$ tons per acre. Millet is the only cultivated hay grass, and it is grown principally in the bottoms. Only 121 acres, yielding 134 tons, were reported in 1909. Yields range from 1 to 2 tons per acre.

Sorghum is the chief coarse-forage crop, but its total acreage is small. In a favorable season it yields 3 to 5 tons per acre. Fertilizer is sometimes used in growing sorghum, at the rate of 100 to 150 pounds per acre. Sorghum is also planted for early pasturage.

Crab grass is troublesome in some places, and where it is permitted to gain a foothold it makes a quick and rank growth. It frequently attains a good growth following the final cultivation of cotton, corn, peanuts, or cowpeas. Where cut in combination with cowpeas it makes a good hay. It is found occasionally in pastures where Bermuda grass is not too thick. Other grasses and plants found in this county which are of value for pasturage are wild barley (*Hordeum pusillum*), Torrey's beard grass (*Andropogon torreyanus*), needle

wire grass (*Aristida stricta*), wild millet (*Chætochloa viridis*), and tallow weed (*Plantago aristato*).⁴

Sorghum is grown on many farms for the production of sirup. Early Orange and Amber, and a variety locally known as "Honey Drip," are grown most extensively. Fertilizer is used for sirup production on some of the upland soils. In good seasons yields average 75 to 150 gallons per acre. The production during the last several years has been curtailed by the dry weather. A small acreage is devoted to ribbon cane, for the production of sirup. This crop is confined chiefly to the bottom lands. An average of about 300 gallons per acre in good seasons is reported, but the ordinary yield is said to be about 200 gallons per acre. There is a steady demand for this sirup, and a good price is maintained.

Irish potatoes, sweet potatoes, watermelons, and cantaloupes are the chief special crops produced in this county. Two crops of Irish potatoes can be produced in one season. The census shows a production of 11,141 bushels from 213 acres in 1909. Ordinary yields range from 50 to 100 bushels per acre. Some farmers use fertilizer on potatoes. The red-skinned varieties of which the Triumph is the most important one in this section seem to be favored. The production of Irish potatoes has been considerably stimulated during the last year or two. Owing to climatic conditions, the keeping qualities of this crop is impaired and it is not grown to any extent to supply outside markets. Of sweet potatoes, the Nancy Hall seems to be the chief variety. Small patches are grown by almost all the farmers for home use and to supply local markets. Watermelons are grown on the lighter soils, chiefly for home consumption, but also for sale on the local markets. Occasionally this crop is shipped to northern markets in carload lots, and this industry seemingly could be profitably extended. The Tom Watson is the chief variety grown and the one used for shipping purposes. Georgia Rattlesnake is popular in some sections. Cantaloupes of good quality are produced in this county, but not to any great commercial extent. It would apparently be profitable to grow this crop for shipment to northern markets.

Peaches are the principal fruit grown in Freestone County. Pears, figs, apples, and plums are also grown, probably ranking in importance in the order named. In order of maturity, the varieties of peach grown are the Mamie Ross, Belle (Georgia Belle), Elberta, and Indian. The Elberta is the most popular variety. No effort is made to do more than supply the local demand, though the Elberta could be profitably raised for shipment to outside markets. Le Conte and Kieffer are the principal varieties of pears grown, apparently be-

⁴ Identification made by Mr. H. Ness, of the Texas Agricultural Experiment Station.

cause they are able to withstand the blight. The Le Conte is the earlier variety. Figs and plums are grown for home preserving and to a small extent for sale on the local markets. There are a few fair-sized apple orchards in this county. Wild plums and grapes are plentiful and are used for making preserves and jellies.

The production of fruits could be much increased and the quality improved if efforts were made to combat the blight, insects, and parasites. No special attention has apparently been given to the care of trees.

There are a few pecan orchards in the county, made up both of seedlings and budded stock. The wild trees seen on the upland seemed to do best in the areas of friable subsoil, and properly selected named varieties of pecans would probably do well on similar soils.

Blackberries and dewberries are grown in small patches near Teague to supply the local and outside markets, and their production could be extended with profit. Strawberries of good quality are grown for home consumption and local sale, and where marketing facilities exist they could no doubt be produced profitably for outside markets, with some irrigation, since early maturity is assured.

The raising of hogs and cattle is a rather important industry at present, particularly in the eastern, rougher, and less thickly populated sections of the county. The Trinity, Tehuacana, Richland, and Keechi bottoms and the adjacent uplands are preferred for cattle raising, since a water supply is assured the greater part, if not all, of the year. Most of the animals are grade stock, but in recent years more interest has been taken in the use of good sires, and purebred Red Poll, Hereford, Shorthorn, and Jersey sires have been imported. The razorback type of hog has been crossed with grade stock in the past, and of late years purebred Durco-Jersey and Poland-China sires have been added to the herds. The cattle are finished mainly on pasturage and the hogs on mast, very little intensive feeding being done except occasionally just before the stock is marketed. Some dairying is carried on in the vicinity of Teague and several other towns to supply the local demand for milk and butter.

Only the more progressive farmers of the county are guided in their methods by a study of crop adaptation. On by far the greater percentage of the farms cotton and corn occupy 75 to 90 per cent of the tilled land, and in a desire to keep the fields constantly in use these crops are merely substituted one for the other in some seasons. Also, the existing system of obtaining credits and of renting tends to restrict crop production to cotton primarily and corn secondarily, regardless of soil conditions. Wheat and oats are more important crops on the prairie soils than on the timbered lands, but this is

largely due to the availability of thrashing outfits and better roads. Peanuts are grown most extensively on the lighter, timbered soils.

Topography has considerable influence on crop distribution. In the timbered portion of the county, where land has never been scarce, farming is concentrated on the more nearly level areas, the rolling, timbered areas being used for pasturage. The proportion of timbered land varies with the roughness of topography, and it is estimated that less than 10 per cent of the upland in the general region of the Trinity River is farmed. The prairie region of the county, though fairly well dissected by streams, is on the whole only gently rolling, and a large percentage of its area is cultivated. The utilization of land for agricultural purposes is influenced to some extent by its position with reference to overflows and in the upland by the presence of heavy timber. Topography affects the size of the individual holdings; the hilly nonagricultural lands are often held in tracts ranging from 1,000 to 5,000 acres or more.

In certain sections of the county there is a considerable area of land on which the yields have become so low with continued cultivation as to be unprofitable. This is ascribed largely to the constant growing of clean-cultivated crops, causing the depletion of natural plant food. Most farmers realize that crop rotation is necessary for the maintenance of a profitable agriculture, but under the prevailing crop system the best rotations can not be practiced. Rotations are practiced on some of the best farms, on which cotton may be grown one or two years, followed by corn (sometimes with cowpeas in the alternate rows) for one year, after which oats are grown, with cowpeas the following year. Peanuts sometimes occupy a place in the rotation. Instead of rotating crops, fields are frequently permitted to lie idle for several years when yields become low. A good rotation should be followed to include a legume at rather frequent intervals, which would improve the soil through the addition of nitrogen and organic matter. The chief aim of a rotation should be to make the farmer independent of outside sources for corn, oats, hay, and forage, to make cotton the surplus instead of the primary crop, and to increase soil productiveness.

The more progressive farmers in Freestone County use modern machinery such as 2-horse plows, cultivators, and disk harrows, and only the removal of stumps, trees, and shrubs is necessary for its use over a large portion of the cultivated lands of the county. Few farmers make any attempt to increase the productiveness of their soils by gradually turning up thin layers of the subsoil or by conserving moisture through the constant maintenance of a soil mulch. Terracing and contour plowing are not always resorted to on the slopes on which erosion may become active, and in the bottom lands large areas now subject to overflow could be used for agriculture if

the channels were cleared of trees and rubbish and straightened to provide a greater fall.

According to the census, there were 3,158 farms in the county in 1910, occupying 56.5 per cent of its total area of 564,480 acres. The average size of the farms, each tenancy being classed as a farm, was 101 acres. Of the area in farms 47.5 per cent, or an average of 48 acres per farm, was improved. The percentage has materially increased since 1910. In the latter year the value of all property per farm was \$1,795, of which 56.8 per cent was land value, 17.6 per cent the value of buildings, 3.5 per cent the value of implements, and 22.1 per cent the value of domestic animals. Farm values increased over 60 per cent between 1900 and 1910.

Only 44.5 per cent of the farms of the county were operated by owners in 1910, the remainder being operated by tenants. By far the greater part of the tenanted farms are operated on a share basis. One-third of the corn and one-fourth of the cotton are given as rental when the work stock, implements, seed, etc., are furnished by the renter. Farms are often rented on a half-share basis, under which the owner of the land furnishes everything except the labor. Very little land is rented for cash. Pasturage on rented lands is generally engaged by the season, the charge being an amount calculated to pay the taxes or slightly more.

Farm labor in Freestone County is chiefly colored, but in certain sections it is mainly white. Farm hands hired for the season are paid \$15 to \$35 a month and board. Day laborers receive \$1 to \$1.75. Cotton pickers are paid from 75 cents to \$1.25 per hundred pounds in a normal season, and somewhat more when the crop is short. These wages represent rates current in 1918, the year in which the survey was made. A total of \$63,819 was expended for labor in 1909, on 997 farms.

Land values vary widely in this county, depending upon the location with respect to markets, the improvements, the amount of clearing and development, and the character of the soil. The prairie lands in the northwestern part of the county range in price from \$25 to \$60 an acre. Timbered lands of the better grade range from \$12 to \$35 an acre. The less desirable farm lands are held at \$5 to \$12 an acre, and the Trinity bottom lands from \$10 to \$25, the price of the latter depending on the location with respect to overflow and the timber growth. Land values have increased considerably over the entire county during the last 10 years.

SOILS.

Freestone County lies entirely within the geological division of the United States known as the Coastal Plain. The underlying strata have been formed by the deposition of sediments in the sea which at

one time covered this area. This deposited material was later exposed by the recession of the sea and the uplift of the land surface. The deposition of this material is thought by geologists to have occurred during the Eocene period of the Tertiary,⁵ and the formation is known as the Wilcox.⁶ The Midway formation⁷ outcrops in the western and northwestern parts of the county.⁸ The Wilcox formation consists of unconsolidated deposits, chiefly sands and clays, interspersed in places with beds of lignite, which sometimes closely approach the surface. A small area of what may be the Navarro formation outcrops in the region of the fault south of what is known to geologists as the Butler salt dome.⁹ This occurs in the eastern part of the county, about $1\frac{1}{4}$ miles northeast of Lakeport.

On the basis of the origin of the soil material the soils of Free-stone County fall into two distinct groups, namely, marine sedimentary, representing the originally deposited marine material, and alluvial, representing the recent deposits along stream courses. The former group includes the upland, while the latter includes the first bottoms and second bottoms or terraces.

Owing to variations in the character of the parent material and to the agencies of weathering, the soils of the county have assumed certain marked characteristics in color of soil and subsoil, and in structure of the subsoil. They are correlated into series, which include types having similar characteristics of origin, color, and drainage. The upland soils are classed in the Susquehanna, Tabor, Kirvin, Lufkin, Ruston, Bowie, Norfolk, Wilson, Crockett, Sumter, and Houston series. The alluvial soils are represented by the Kalmia, Cahaba, Leaf, Myatt, Trinity, and Ochlockonee series. Of the upland soils the Crockett, Wilson, Houston, and Sumter were developed under grass cover, while the rest were developed under tree cover. The grass covered or prairie region lies north of a line drawn from the southwest county line eastward to Cotton Gin, north to Tehuacana Creek, and along this stream to the Kirvin-Streetman Road, which it roughly follows northward out of the county. The upland peninsula extending across the county line between Richland Creek and Trinity River at the northern corner of the county is also prairie. The remainder of the upland of the county is forested, except for occasional small patches of prairie.

The upland forested soils may be divided into two general groups—those with friable subsoils and those with heavy, plastic subsoils.

⁵ Review of the Geology of Texas, by J. A. Udden et al., pp. 80–84.

⁶ This formation is also known in Texas as the Lignitic, Sabine, Sabine River, and Timber Belt formation.

⁷ The Midway formation is also known as the Basal, or Wills Point.

⁸ Personal interview with Lewis C. Chapman, geologist.

⁹ See Bulletin 661G of the United States Geological Survey, by Oliver B. Hopkins.

The greater part of their area falls within the former group. The largest area of soils with friable subsoils is found east of a line drawn northward from Burleson Hill to the Trinity River, and south of a line from the first-named place, swinging in a curve of large radius to Grove Island Church, the convex side of the circle to the south. Another large area is found along Tehuacana Creek, extending 10 miles westward from its junction with Cottonwood Creek. The region of heavy subsoils is bounded on the east and south by the large area mentioned above and on the west and north by the prairie belt. Small areas of soils with friable subsoils are scattered throughout the area of forested types having heavy subsoils. The forested upland series having heavy subsoils are the Susquehanna, Tabor, Kirvin, and Lufkin, and those having friable subsoils are the Ruston, Norfolk, and Bowie. The prairie soils of the county have heavy subsoils.

There are two classes of alluvial soils in the county—those lying above flood level and those subject to overflow. The soils lying above overflow and occupying terraces or second bottoms are included in the Kalmia, Cahaba, Leaf, and Myatt series, of which the first two have friable subsoils. The first-bottom or overflowed soils are classed in the Ochlockonee and Trinity series.

The Susquehanna series is characterized by gray soils overlying mottled red, yellow, and gray, heavy, plastic subsoils. Better drainage and consequent more thorough oxidation and aeration have caused this series to differ in some measure from the Tabor, which has gray to dark-gray soils and yellowish-brown to brown or brown and gray, mottled subsoils of heavy texture and plastic structure. The Lufkin series is still more poorly drained than the Tabor. It is characterized by gray soils and gray to dark-gray, heavy, plastic subsoils. The subsoil of the Kirvin series is similar to that of the Susquehanna, but the surface soil ranges from reddish brown to red. The Kirvin soils are related to the Susquehanna in the same manner that the Greenville soils, mapped in other parts of the Coastal Plain, are related to the Orangeburg. The subsoil color is a deeper red than that of the Susquehanna.

The friable subsoils of the Ruston, Norfolk, and Bowie series are due to better drainage and aeration and perhaps to the presence of less clay and more sand in the parent material. The soil of the Ruston series is mainly brownish gray, overlying a dull-red subsoil. A noticeable feature of this series as here developed is the occurrence in the lower subsoil and substratum of a thin layer of sand, cemented by iron salts. The soils of the Norfolk series are predominantly gray, with a yellow to lemon-yellow subsoil. The surface soil of the Bowie series is gray to slightly brownish gray, while the subsoil is yellow with red splotches, which become more conspicuous with depth.

The prairie soils of the county are included in the Crockett, Wilson, Houston, and Sumter series, and to a small extent in the Tabor series, already described. The Wilson soils are black, and the subsoil is black, gray, or olive colored, generally the last. The material is of low lime content, and more inclined to bake on drying than the crumbly Houston soils. The Crockett soils are mainly dark gray in the surface layer, with heavy subsoils which range from red in the upper portion to olive and sometimes gray in the lower portion. The Crockett soils are calcareous in the subsoil. They represent a gradation between the noncalcareous forested soils like the Susquehanna, and the highly calcareous, prairie soils of the black-land belt, classed in the Houston series. Eroded slopes in areas of the Crockett soils are occupied by the Sumter soils, which are generally brown, with a yellowish-brown to greenish-yellow, calcareous subsoil, heavy textured and plastic in structure. The Houston soils range from dark gray to grayish brown, overlying a subsoil of light-brown to grayish-brown or greenish-yellow color and heavy structure. The material is more calcareous than that of the Crockett.

The Kalmia and Cahaba series both have friable subsoils, and in each the surface soils range from gray to brownish, the Cahaba soils inclining more toward the latter. The subsoil of the Cahaba is either red or red mottled with yellow or gray, while the subsoil of the Kalmia is generally yellow. The Kalmia soils are not so thoroughly drained as the Cahaba. The soils of the Leaf series are grayish brown, while its heavy, plastic subsoil is generally red in the upper portion and mottled red, yellow, and gray in the lower portion. In some cases the upper subsoil also may be mottled. The soil of the Myatt series is gray, while the subsoil is generally gray or dark gray mottled with yellow or brown throughout, or at least in the lower portion. The subsoil is heavy and compact in structure. The Myatt soils are less well drained than the Leaf.

The Ochlockonee soils range from grayish brown to dark brown, and the subsoils from dark gray to brown, with occasionally a layer of gray silty material between the soil and subsoil in the case of the heavier types. Drainage is only fairly good. The series is composed of locally derived sedimentary material occupying first-bottom positions. The material making up the black soils and black to gray, heavy subsoils of the Trinity series has been derived from the Cretaceous prairies to the north and west.

The table following gives the names of the different soils mapped in Freestone County and the actual and relative extent of each.

Areas of different soils.

Soil.	Acres.	Per cent.	Soil.	Acres.	Per cent.
Susquehanna fine sandy loam.....	160,320	28.8	Myatt very fine sandy loam.....	1,984	0.4
Ruston fine sandy loam.....	94,726	17.0	Susquehanna gravelly fine sandy loam.....	1,920	.3
Norfolk fine sand.....	59,008	10.6	Cahaba fine sandy loam.....	1,728	.3
Norfolk fine sandy loam.....	40,128	7.2	Lufkin fine sand.....	1,664	.3
Ochlockonee fine sandy loam.....	38,720	6.9	Leaf fine sandy loam.....	1,600	.3
Trinity clay.....	35,072	6.4	Norfolk sandy loam.....	1,600	.3
Terrace phase.....	384		Sumter clay loam.....	1,216	.2
Bowie fine sandy loam.....	26,752	4.8	Kalmia fine sandy loam.....	1,152	.2
Crockett fine sandy loam.....	15,680	2.8	Wilson silt loam.....	1,088	.2
Tabor fine sandy loam.....	13,120	2.4	Ruston fine sand.....	832	.1
Ochlockonee silty clay loam.....	11,136	2.0	Tabor very fine sandy loam.....	704	.1
Norfolk sand.....	9,280	1.7	Houston clay loam.....	640	.1
Crockett loam.....	8,512	1.5	Susquehanna clay loam.....	576	.1
Ruston gravelly fine sandy loam..	7,296	1.3	Kirvin gravelly fine sandy loam..	512	.1
Ochlockonee silt loam.....	6,976	1.3	Total.....	557,440
Ochlockonee clay	6,208	1.1			
Lufkin fine sandy loam.....	4,416	.8			
Myatt clay loam.....	2,496	.4			

SUSQUEHANNA GRAVELLY FINE SANDY LOAM.

The soil of the Susquehanna gravelly fine sandy loam ranges in depth from 6 to 10 inches, averaging about 8 inches. It varies in texture from a loamy fine sand to a fine sandy loam, and in color from gray to grayish brown or brownish gray. The subsoil to a depth of 20 to 28 inches consists of a heavy, red, stiff clay of compact, plastic structure and generally mottled with yellow and gray, the mottling becoming more pronounced with depth. Below the depth named the subsoil in places consists of a mottled gray, yellow, and red, stiff, heavy, plastic clay, while in other places it is often mottled gray and red or gray and yellow. Some bodies have a lower subsoil of gray or olive-colored, stiff, heavy clay. In the better drained areas the heavy, red subsoil may extend to more than 36 inches. The subsoil when wet is very sticky and plastic.

Gravel is present on the surface and in the upper few inches of the subsoil. It may consist entirely of rounded quartzitic material, generally of uniform size, about 1 to 1½ inches in diameter, or of highly ferruginous sandstone fragments, generally subangular, and ranging from one-half inch to 3 inches in diameter. A noticeable feature is the occurrence between the soil and subsoil of large amounts of ferruginous material of the size of small gravel, occurring occasionally in quantities sufficient to prevent penetration. Another characteristic is the occurrence of plates of ferruginous sandstone a foot or more in diameter and an inch or two in thickness.

The type as mapped includes some areas which are intermediate between the Susquehanna and the gravelly fine sandy loam of the Kirvin series.

The Susquehanna gravelly fine sandy loam is not an extensive soil in Freestone County. It is largely confined to the section between Beene and Freestone and to the vicinity of Cotton Gin.

Its topography varies from nearly flat to gently undulating, and drainage ranges from fair to good. The heavy subsoil retards the movement of soil moisture, and the type is inclined to droughtiness. Less than half of its total area is under cultivation. The growth on the forested areas consists mainly of blackjack oak, post oak, hickory, and some elm. Cotton is said to yield an average of one-fifth to one-third bale per acre. Corn yields 10 to 20 bushels per acre.

SUSQUEHANNA FINE SANDY LOAM.

The typical Susquehanna fine sandy loam is a brownish-gray loamy fine sand to light-brown fine sandy loam, passing at about 6 inches into pale-yellowish loamy fine sand or fine sandy loam, which is underlain at any depth from 8 to 15 inches by mottled red and yellow clay, stiff when dry and plastic when wet. While the upper part of the subsoil is frequently a red clay with little or no mottling, yellow mottling invariably becomes increasingly conspicuous with depth, the lower subsoil often showing more yellow or gray mottling than red; in many places the lower subsoil is yellow or mottled yellow and gray without any red.

In some places there is a greater depth to the clay, which is encountered at 18 to 24 inches and the surface soil is lighter colored, less loamy, and loose. The soil here consists of gray fine sand or loamy fine sand, passing into pale-yellow fine sand or loamy fine sand, and this gives way to yellow fine sandy loam just above the clay subsoil. Occasionally the upper subsoil is mottled yellowish and grayish and is not so stiff as the clay beneath which shows red mottlings. Areas are found in which the lower subsoil is an olive-colored plastic clay. In some places the soil is so closely associated with patches of Bowie and Norfolk fine sandy loam and eroded patches of Susquehanna clay loam that they can not be separated. Such areas occur between Turlington and Butler.

In timbered areas the soil is often light brown and occasionally distinctly brown, representing a gradation toward the Kirvin soils. Poorly drained, flat areas frequently have a surface soil of light-gray fine sandy loam, and sometimes the surface soil in such situations becomes a very fine sandy loam. In these areas the lower subsoil frequently assumes the color and structural characteristics of the Lufkin or Tabor series, though the upper subsoil is typical Susquehanna.

Some small areas in which the subsoil is sufficiently close to the surface to be plowed up are necessarily included in the type as mapped. The surface texture of these areas varies from loam to clay loam.

The lack of uniformity in the Susquehanna fine sandy loam is further increased by the inclusion of small areas of fine sandy loam of the Bowie, Ruston, Tabor, and Lufkin series. Cuts frequently show the presence of all these types within 100 feet. Small areas of Susquehanna gravelly fine sandy loam are also included, the gravel consisting of rounded quartzitic material or ferruginous material of different sizes. In the region of medium sand soils north and west of Teague some of the material mapped with this type may be a sandy loam.

Two noticeable features of the subsoil of the Susquehanna fine sandy loam are its extreme plasticity, retarding the movement of soil moisture, and the added prominence of the red color when the material is moist. Along the line of contact between the areas in which the Ruston and Susquehanna soils predominate it is frequently impossible to draw definite boundaries. This is particularly true in the territory north of Turlington extending to Spring Bank School.

The Susquehanna fine sandy loam in Freestone County occurs most extensively in an area extending from Teague north to Tehuacana Creek, south to Freestone, west to the county line, and east to Burleson Hill. It varies from nearly flat to gently rolling, the greater part probably being gently undulating or nearly flat. The run-off is fairly adequate but the internal movement of soil waters is restricted. The subsoil structure is such as to favor the formation of deep V-shaped gullies, locally termed "dugouts." These frequently cut back 100 feet or more during a severe rain, and great care must be exercised to prevent their formation. Seeding Bermuda grass at the heads of these gullies and the depositing of brush and logs are generally relied upon for this purpose.

About 45 per cent of this soil is under cultivation. The principal timber growth on the virgin areas consists of post oak and blackjack oak, with hickory and elm quite prominent in some sections. Cotton occupies about 75 per cent of the cultivated area. Yields vary considerably with the seasonal conditions, the cultural methods, and the extent of the ravages of the boll weevil. The average probably ranges from one-fourth to one-third bale per acre, with occasional yields of three-eighths to three-fourths bale per acre. The largest yields are only obtained with the aid of commercial fertilizers. At present these are generally of a 10-16.5-0¹⁰ brand, and applications vary from 100 to 200 pounds or more per acre. Corn ranks next in importance among the crops. Yields of 10 to 25 bushels per acre are

¹⁰ Fertilizer formulas are stated in the order of percentages of phosphoric acid, nitrogen, and potash.

obtained, a fair average being about 15 bushels. Oats are grown by some farmers for winter and spring pasturage and for summer and fall feeding in the straw. Several fields were devoted to wheat in 1918, and good yields are said to have been obtained. Peanuts are becoming a more popular crop, especially where the surface soil is deeper. This legume makes an excellent step in crop rotations. Irish potatoes, sweet potatoes, watermelons, and various garden crops are grown, but generally in too small quantities to supply the local markets. Peach orchards have been set out on most farms, but the trees seem to be more short lived than on soils where root development is not hampered by a stiff, heavy subsoil. Pear trees are common in the orchards on this soil.

The use of fertilizers on the Susquehanna fine sandy loam has increased of late years as a result of the constant growing of clean-cultivated crops. In former years, when unused land was plentiful, fields were permitted to lie idle when yields decreased below a profitable figure, and new lands were cleared. In addition to the commercial fertilizer used at present, home mixtures of cottonseed meal and acid phosphate are applied by many farmers.

For the maintenance of a successful agriculture on this soil leguminous crops should be grown in a system of rotation to increase the content of nitrogen and organic matter. Incidentally this would assist in the prevention of soil erosion, and also increase the moisture-holding capacity of the soil. In the more rolling areas terracing is necessary to prevent ruinous soil erosion. Owing to the generally shallow surface soil and the heavy subsoil, the type is susceptible to drought, and constant cultivation, to keep a surface mulch, is necessary. The installation of tile drains on some of the flatter areas should prove beneficial. The soil is either acid or only neutral, and applications of ground limestone would no doubt be beneficial. The tilth and productiveness of the type would be increased by turning up small layers of the subsoil in the shallower areas.

Land values on this type range from \$8 to \$25 or more an acre,¹¹ depending on the location, improvements, acreage cleared, and other factors.

SUSQUEHANNA CLAY LOAM.

The soil of the Susquehanna clay loam where uncultivated consists of 3 or 4 inches of brownish-gray to grayish-brown fine sandy loam. In cultivated areas the subsoil material produces a surface soil varying in texture from sandy clay loam to clay loam, and in color from brown to red, according to the proportion of incorporated subsoil material. The typical subsoil consists of a red, stiff, heavy clay, of compact structure, which may extend to 36 inches without much

¹¹ Land values stated in this report refer to the year 1918.

change, but which is usually mottled with gray or yellow in the lower part. Often the subsoil is mottled in the upper portion with yellow or gray, or both. Where the gray mottling occurs it becomes more intense with depth. In some areas the subsoil at 24 to 36 inches is a gray, heavy, stiff clay, containing mottlings of red and sometimes yellow. Ferruginous gravel is present in the soil of some areas.

As mapped, the type includes small areas which would be included in the Kirvin series if of sufficient extent to warrant correlation with that series. On the other hand, some small areas of Susquehanna clay loam are included in the more rolling areas of the Susquehanna fine sandy loam.

The Susquehanna clay loam occurs mainly on stream slopes, where drainage is excessive. The type needs terracing to prevent damaging erosion. The heavy subsoil and the shallow surface soil cause the type to be droughty, but this tendency could be obviated to some extent by incorporating organic matter in the surface soil. The plowing up of subsoil material, as a consequence of the shallowness of the surface material, at first renders the soil less productive, but with aeration and weathering of the newly plowed material the type becomes better suited to agriculture than in its typical condition.

The following table gives the results of mechanical analyses of samples of the soil, subsoil, and lower subsoil of the Susquehanna clay loam:

Mechanical analyses of Susquehanna clay loam.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.
445228.....	Soil.....	0.2	0.5	0.5	20.1	38.8	21.2	18.7
445229.....	Subsoil.....	.7	1.2	.7	15.9	24.3	19.4	39.0
445230.....	Lower subsoil...	.3	.7	2.0	15.2	13.9	34.5	33.4

TABOR FINE SANDY LOAM.

The soil of the Tabor fine sandy loam typically consists of a grayish-brown to brown loamy fine sand to fine sandy loam, extending usually to a depth of 6 to 10 inches. It may pass abruptly at this depth into a yellowish-brown to yellow, or a mottled yellowish and grayish, plastic, heavy clay, or it may pass first into a substratum of yellow to yellowish-brown or grayish-brown fine sandy loam, varying in thickness from 2 to 6 inches, and then into the material above described, which may extend to depths of 3 feet. Frequently there is faint reddish mottling in the upper subsoil, such areas representing a gradation toward the Susquehanna soils. As mapped, the type includes some typical Susquehanna fine sandy loam. Fre-

quently the subsoil, especially in the lower part, consists of an olive-colored, heavy, plastic clay, similar to that found in some areas of the Crockett series, but the material is of low lime content, whereas the Crockett is often high in lime. As a whole, the type represents a poorly drained equivalent of the Susquehanna, occupying as it does flat areas on divides and at the heads and sides of minor drainage ways throughout regions in which the Susquehanna soils predominate.

The greater part of this type is mapped in small areas within a 15-mile radius of Teague. Some small patches of the type are necessarily included in the Susquehanna fine sandy loam, with which the Tabor in most cases is closely associated.

Owing to the generally flat or nearly flat surface of this type, its drainage is inadequate, and tile could be installed to advantage in most places.

This type is forested, principally with post oak, blackjack oak, and hickory. It includes, however, some prairie areas along the margin of the forested portion of the county, as well as small prairie areas in the midst of the forested region. Where the type grades into the Crockett soils the boundary is drawn on the basis of the presence of concretions of calcium carbonate in the deep subsoil, these concretions being characteristically present in the Crockett and absent in the Tabor. Small quantities of these concretions, however, are observed in typical Tabor soils in small isolated areas. Hydrochloric-acid tests showed the absence of lime in this type even where cedar, ordinarily a lime-loving plant, grows at the head of draws.

A large proportion of the Tabor fine sandy loam is under cultivation. Cotton and corn are the chief crops grown. The yield of cotton ranges from one-fifth to one-third bale per acre, and of corn from 8 to 20 bushels. Where cowpeas are sown in alternate rows with corn, yields of 15 bushels of corn per acre are usually obtained. The cowpeas are later pastured. A few fields are devoted to peanuts, but this crop seems not to do as well as on the better drained types having more friable subsoils. Where the soil is deeper than typical, however, or the light textured layer occurs between the soil and subsoil, fairly good yields are obtained. Seasonal conditions have a great influence on crop yields. The type is inclined to be droughty during continued dry weather, as the heavy subsoil prevents the percolation and capillary rise of soil moisture. Planting and proper cultivation are delayed, or made impossible at times, during wet seasons.

This type could be improved by the use of tile drains, the growing of leguminous crops to add nitrogen and organic matter, constant cultivation during the dry season to retain soil moisture, and the

adaptation of some form of crop rotation to increase the productivity.

Land of this type sells at \$10 to \$35 an acre, depending on the location with reference to markets, the improvements, and other local conditions.

TABOR VERY FINE SANDY LOAM.

The Tabor very fine sandy loam consists of a gray to grayish-brown or brown loamy very fine sand or very fine sandy loam, underlain generally at 8 to 10 inches by mottled grayish and yellowish, heavy, plastic clay, or a yellow or olive-colored, heavy clay, which may be mottled in the upper part with gray and sometimes with red. This material extends throughout the 3-foot section. Where the red mottling is present the soil represents a gradation toward the Susquehanna series, and some small areas of the Tabor are included in the Susquehanna fine sandy loam as mapped. The surface soil becomes as heavy as a silt loam in places, and a few small areas of Tabor loam are included, the largest occurring 1 mile south of Burleson Hill.

The Tabor very fine sandy loam occupies flat areas in the upland, or at the head and along the sides of small streams. Its total extent in Freestone County is small. It occurs generally in small isolated areas in the general region of the Susquehanna soils. Drainage is inadequate for best results during wet seasons, while, on the other hand, the type is subject to droughtiness during continued dry weather.

There is apparently little difference in productiveness between this type and the Tabor fine sandy loam, and it can be improved by the same means that are suggested for the fine sandy loam.

KIRVIN GRAVELLY FINE SANDY LOAM.

To an average depth of 8 to 10 inches the Kirvin gravelly fine sandy loam consists of a brown to reddish-brown or brownish-red fine sandy loam to loamy fine sand, containing a large proportion of ferruginous fragments, generally subangular, as well as concretions of a highly ferruginous nature. The upper subsoil consists of a red, heavy clay of stiff and compact structure, and plastic when wet. This may extend to a depth of 3 feet or more without change, or some yellow or yellowish-brown mottling may occur in the lower part. Generally the subsoil changes at about 24 inches to a red and yellow mottled, heavy, stiff clay, of compact structure and plastic nature when wet. Some gravel may be present in the upper subsoil, but gravel is rarely found in the lower subsoil. In places platy rock of ferruginous nature and an inch or more thick is found between the soil and subsoil. These fragments appear to have been

formed in place, due to the cementing action of iron salts, in which this soil seems to be naturally high. Some stone-free areas are included with this type. The greater portion of the Kirvin gravelly fine sandy loam is mapped in the vicinity of Kirvin. It occurs in scattered patches, and its total extent is small. The type occupies knolls and ridges in a gently rolling country, and drainage is good to excessive. The type is inclined to be droughty in dry seasons, and crops suffer from lack of moisture. Terracing is necessary in some of the cultivated areas to prevent ruinous erosion, and fields not terraced should be plowed and cultivated along the contour lines.

Cotton and corn are the leading crops on this soil. The type seems to be more productive than the gravelly fine sandy loam of the Susquehanna series. Cotton is said to average one-fourth to one-third bale per acre, and corn 15 to 20 bushels.

LUFKIN FINE SAND.

The Lufkin fine sand, to an average depth of 8 to 10 inches, consists of a gray to slightly brownish gray loamy fine sand. This passes into a dingy white or light-gray fine sand, which extends to a depth of more than 3 feet. Small areas of medium sand of similar characteristics are included in the type as mapped, as well as some patches of flat forested land and small areas of Muck along the streams. On slopes from the Norfolk fine sand to this type the soil often resembles the Plummer fine sand; where the slope is more gradual the soil is similar to the Portsmouth fine sand. (The Plummer and Portsmouth are, respectively, wet gray and wet black soils mapped elsewhere in the Coastal Plain.)

The Lufkin fine sand occurs in close association with the Norfolk sands. It occupies open glades as well as flat areas about the heads of small streams and along their courses. Springs are of common occurrence in the region of this soil.

In the forested areas the growth is the same as that on the Norfolk fine sand, except for the absence of turkey oak. Myrtle is common in such areas. A swampy growth is sometimes found along the streams fed by springs, myrtle and bay, with a thick undergrowth of bamboo, being common.

The type is not farmed owing to its low agricultural value. On open glades there is often a growth of prairie grasses which are cut for hay.

LUFKIN FINE SANDY LOAM.

The soil of the typical Lufkin fine sandy loam consists of a gray to dark ashy gray or brownish-gray fine sandy loam, 6 to 8 inches in depth. This overlies a subsoil of dark-gray, stiff, heavy clay, which is plastic when wet. The subsoil may be mottled with slightly lighter

gray, or yellowish and rusty brown, and it is generally marked with iron stains of ocherous yellow and rusty brown. Iron concretions are often present in the subsoil, and are quite prominent in places. In some areas the subsoil is light ashy gray. A few small areas included in this type are a very fine sandy loam, and others a silt loam. A few small areas are included in which the surface soil is a typical clay. About $3\frac{1}{2}$ miles west of Fairfield one fair-sized area has a clay loam soil about 8 inches deep, overlying a subsoil of gray, heavy clay loam to clay.

Where the type occupies flats and depressions the surface soil sometimes assumes a dark gray color when dry. Below this there generally occurs a layer of light-gray silty or very fine sandy loam, 2 to 6 inches in thickness. The typical Lufkin subsoil is present below this layer.

The Lufkin fine sandy loam occupies flats and depressions in the Susquehanna and Tabor soils, and flat areas at the heads of streams and for short distances along their upper courses. The type in general is poorly drained, water standing in pools for considerable periods in some locations.

Very little of the type is under cultivation, but it is said to be a strong, productive soil in seasons of normal distribution of moisture. The ditching and tiling of this type where possible would prove beneficial, and crops above the average would be assured in normal seasons.

RUSTON GRAVELLY FINE SANDY LOAM.

The surface soil of the Ruston gravelly fine sandy loam varies in depth from 4 to 15 inches, and consists of a brown, grayish-brown, or reddish-brown loamy fine sand to fine sandy loam. This passes into a dull-red, compact but generally friable, clay loam, 6 to 15 inches thick, which gives way gradually to a slightly lighter red, friable fine sandy clay. This sandy clay assumes mottlings of yellow and gray with depth, and the lower part of the 3-foot section sometimes consists of a red and yellow, or a red, yellow, and gray, mottled fine sandy clay. Some yellow mottling is present in the clay loam layer in some areas. The clay loam layer occasionally is lacking, the soil passing immediately into a dull-red friable sandy clay, slightly compact in the upper part. The reddish colored areas, containing ferruginous fragments, represent an inclusion of Kirvin gravelly fine sandy loam.

Scattered over the surface and throughout the soil and upper subsoil are large quantities of small iron concretions and small angular fragments of ferruginous sandstone. There are also found on the surface and in the surface soil both small and large chips and platy fragments of ferruginous sandstone, and on the crests of some of the ridges there are large fragments of sandstone conglomerate.

Some quartz gravel is found in places. On some of the slopes the sandy material has been removed and the gravel entirely covers the surface.

The greater part of the type occupies high hills, with moderate to steeply sloping sides. It is mapped on the highest upland near the Trinity River bottoms and for some distance back from the stream. The largest area occurs in the vicinity of Pilot Knob. Even where the topography is favorable, cultivation is precluded by the abundance of gravel and boulders. Most of the type is excessively drained and erosion is active, at least moderately, at all times. The land is used mainly for pastures. It is forested with the growth common to the county, oak predominating. The mast from the trees makes excellent forage for hogs.

This land is valued at from \$8 to \$15 an acre, or slightly more where it occurs in farms with types that are more valuable for agriculture.

RUSTON FINE SAND.

The Ruston fine sand consists of a grayish-brown to gray fine sand to loamy fine sand, which passes at 3 to 6 inches into light-reddish fine sand, the latter extending to a depth of 3 feet or more. In places the subsoil is light reddish yellow, resembling the Norfolk fine sand.

Only a small total area of Ruston fine sand is mapped in Freestone County, and this is confined to isolated patches on the upland in the eastern part of the county. The surface is nearly level or only undulating, but drainage is good to excessive, owing to the loose character of the soil and subsoil. The type would probably be droughty if subjected to a long dry spell, but it retains moisture fairly well. Very little of this soil is used for agriculture. Where it is forested it supports the dominant upland growth of the county. Yields of cotton and corn average slightly higher than on the Norfolk fine sand. The selling value of land ranges from \$10 to \$20 an acre.

RUSTON FINE SANDY LOAM.

The typical Ruston fine sandy loam consists of a grayish-brown to brown loamy fine sand to fine sand, 6 to 10 inches deep, overlying a thin layer of yellowish-brown to yellow loamy fine sand or fine sandy loam. This quickly passes into a dull-red or yellowish-red fine sandy clay to clay loam, slightly mottled in places with yellow and sometimes with gray. This upper subsoil layer ranges in thickness from 6 to 12 inches. In some places it directly underlies the surface soil, the transition being abrupt. It grades beneath into a lighter red or yellowish-red friable fine sandy clay, which contains mottlings of yellow and sometimes of gray and extends throughout

the 3-foot section. In places the lower part of the 3-foot section consists of a mottled red and yellow, or red, yellow, and gray, friable fine sandy clay. Small iron concretions and small angular fragments of ferruginous sandstone are found on the surface and in the soil over a large part of the type. In some places platy fragments of ferruginous sandstone are scattered over the surface, and occur also between the soil and subsoil.

A variation of the type as mapped consists of 8 to 12 inches of grayish-brown to brown loamy fine sand to fine sand, which passes through yellowish-brown or yellow loamy fine sand to fine sandy loam into a red, friable fine sandy clay. With increase in depth this becomes lighter in color and mottled with yellow, and at depths of 3 feet it gives way to a yellowish-red, friable fine sandy clay, mottled with yellow and sometimes gray. There are some included patches of Orangeburg fine sandy loam, a type with a deep-red subsoil.

The Ruston fine sandy loam is a fairly extensive soil and one of considerable importance agriculturally. It occurs most extensively in the eastern and southern parts of the county. The type has a wide range in topography, from undulating to rolling or hilly. Erosion is rather active on cultivated sloping areas, and the more rolling or sloping areas are used mainly for pasturage, and are permitted to remain in forest. Perhaps 20 per cent of the type is nearly level or gently undulating, and it is on these areas that agriculture is mainly developed. Here the drainage is good, while elsewhere it is often excessive. The soil retains moisture fairly well, but in continued dry weather is somewhat inclined to be droughty unless a surface mulch is maintained.

In its natural condition the Ruston fine sandy loam is forested with post oak, blackjack oak, red oak, black oak, hickory, elm, and other common species of trees. The mast furnished by the oaks makes the type suitable for the fall pasturage of hogs, and this is a common practice in the eastern part of the county. Bermuda grass does well on this soil, and the rolling to hilly areas are well suited to pasturage. Cotton, corn, oats, peanuts, and cowpeas give good results. In seasons of normal rainfall distribution cotton yields one-fourth to one-half bale or more per acre. The yield of corn ranges from 12 to 25 bushels per acre, depending to some extent on the cultural methods. Winter oats for spring pasturage and for feeding in the sheaf are often grown, and a good stalk with well-filled heads is obtained.

The price of this land varies largely with the location, topography, and other local conditions. In general, it ranges from \$10 to \$35 or more an acre.

The incorporation of organic matter in the surface soil is necessary in most areas of this soil. Barnyard manure should be applied or green crops turned under. Ruinous erosion and gullying should be prevented by means of terracing, or at least the fields should be plowed at right angles to the slope, following the contour. The variety of crops which can be grown on the type is sufficient to make a rotation easy to follow, and a definite plan should be followed.

BOWIE FINE SANDY LOAM.

The Bowie fine sandy loam, to an average depth of 8 to 14 inches, consists of a brownish-gray to grayish-brown loamy fine sand to fine sandy loam. This passes into a layer of yellow fine sandy loam, 6 to 10 inches thick, overlying a subsoil consisting of yellow fine sandy clay, friable though sometimes slightly compact. This subsoil is mottled in the upper part with red, which assumes a splotchy appearance with depth. In the better drained areas the red splotches sometimes become very prominent in the lower subsoil, and the material below 3 feet may resemble that of the Ruston series in color. In some places, mainly in the flatter areas, there is a small amount of fine gray mottling in the subsoil. Occasionally the subsurface layer of yellow fine sandy loam is absent, the red mottling becoming prominent as soon as the heavier material is reached. A few small areas occur in which the surface soil has a depth of 18 inches or more.

A variation of this type occurs in which the upper subsoil is slightly heavier and more compact than typical. It is sometimes a clay loam or heavy fine sandy loam, but its structure remains comparatively friable. The lower subsoil not infrequently is more sandy than the upper subsoil, but it may be even more compact. There is apparently no essential agricultural difference between this variation and the typical soil.

The Bowie fine sandy loam occurs throughout the forested section of the county. In the regions of heavy subsoil it occupies knoll-like areas, slightly above the general level of the country. Large areas are found in the regions where friable subsoils predominate. The type is associated with the Norfolk and Ruston soils, and as mapped may include some small areas of those types. Like the other Bowie soils it seems to represent an intermediate stage of development between the Ruston and Norfolk.

The topography in general ranges from nearly level to undulating, but small areas here and there may be flat. Drainage is adequate, however, largely owing to the pervious character of the subsoil. The subsoil is nevertheless very retentive of moisture, which it retains longer than most, if not all, of the other upland soils. Where the natural capillarity of the soil is aided by the maintenance of a surface

mulch the type is more retentive of soil moisture than any other soil in the county.

The Bowie fine sandy loam is regarded as the best upland soil in the forested part of the county, and probably 85 per cent of it is under cultivation. Some fields that have been continuously cropped for 30 years or more are still under cultivation, and the yields are profitable though greatly reduced. Fallowing is sometimes resorted to in order to restore the productiveness. The forested portion of the type supports the typical upland growth, with post oak, blackjack oak, and hickory predominating.

Cotton, the most important crop on the Bowie fine sandy loam, ordinarily yields three-eighths to one-half bale per acre, and larger yields are obtained in favorable years. Some farmers produce as much as 1 bale per acre. Corn yields 15 to 25 bushels per acre. Fertilizer is seldom applied except in the case of "worn out" fields. Peanuts and cowpeas both do very well on this type. Winter oats make a good plant growth, and the heads are generally long and full. If the crop were thrashed, a high average yield would be obtained. The type gives good results with watermelons, cantaloupes, Irish potatoes, sweet potatoes, and garden vegetables. Peach and pear trees yield well. There are a few pecan trees on this soil, and there would seem to be some promise of the development of commercial production of this nut on this soil.

The selling price of this land depends on the farm improvements and the position with respect to towns and markets, and varies from \$15 to \$35 or more an acre.

This soil naturally is highly retentive of moisture, but the maintenance of a surface mulch is necessary for best results. A systematic crop rotation should be worked out and adhered to, and the legumes should be included in this for the purpose of adding nitrogen to the soil. The plowing under of green crops, even weeds, or stable manure, is of the highest value for supplying organic matter. In many areas yields could also be increased by the addition of lime. With good farming methods this soil should be stronger agriculturally than any of the other upland sandy types.

The following table gives the results of mechanical analyses of samples of the soil, subsoil, and lower subsoil of the Bowie fine sandy loam:

Mechanical analyses of Bowie fine sandy loam.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.
445231.....	Soil.....	0.1	0.7	0.6	48.1	29.5	17.4	3.2
445232.....	Subsoil.....	.0	.6	.9	47.7	21.8	14.9	13.8
445233.....	Lower subsoil...	.0	.4	.6	39.1	21.3	18.9	19.3

NORFOLK SAND.

The Norfolk sand is a gray to brownish-gray, loose, medium sand, underlain at 5 to 15 inches by yellow, medium sand. In places the lower subsoil ranges to a slightly loamy, medium sand of yellow color. The transition from soil to subsoil often takes place through a layer of grayish-yellow sand 3 to 6 inches in thickness.

The type occurs in association with the Norfolk sandy loam and Ruston fine sandy loam in the region of medium-textured soils north of Teague. The greater part of it is included in the large area northeast of Fosters Switch. Small areas of the associated soils are necessarily included with the type in places.

The topography ranges from nearly flat to rolling. Drainage is excessive, owing to the open nature of the subsoil. The type holds moisture surprisingly well, however, where a surface mulch is maintained.

Very little of this soil is under cultivation. Post oak, blackjack oak, turkey oak, and hickory are the principal growths in the forested areas, most of which are used for pasture. Turkey oak is characteristic of the medium sand and the fine sand of the Norfolk series. The natural productiveness of the Norfolk sand is low. Yields are about the same as on the Norfolk fine sand. The type needs more organic matter and heavy fertilization.

NORFOLK FINE SAND.

The Norfolk fine sand is a gray or slightly brownish gray, loose fine sand, from 3 to 5 inches deep. The subsoil is a yellowish-gray to pale-yellow, and in places almost white, loose fine sand extending to depths of 3 feet or more. Occasionally the immediate surface soil has a slightly loamy feel, owing to the vegetable matter present, but characteristically the content of vegetable matter is low and the soil is incoherent.

This type occurs in large areas in the southern and eastern parts of the county, mainly in the vicinity of Martintown and Mount Pleasant Church, west of Oakwood, and in a long strip of country east of Turlington. Smaller areas are found throughout all of the regions where friable subsoils predominate, and isolated areas are mapped in the regions of heavy subsoil. The type is associated with the fine sandy loams of the Bowie, Ruston, and Norfolk series, and some areas of those soils are necessarily included with it on the map, owing to their small size.

The Norfolk fine sand varies from gently undulating to rolling, and the surface relief, together with the porous nature of the subsoil, is responsible for excessive drainage. Nevertheless, the soil retains moisture for a surprisingly long time during droughty periods,

possibly owing to the loose structure of the surface material which acts as a mulch.

The natural productiveness of this type is low. Seventy-five per cent or more of it is forested, and the greater part is used for pasture. It is well adapted to stock raising, since it includes a large number of small springs and has a fair growth of native grasses where the underbrush is not too thick. Cotton, corn, and peanuts are the leading crops. Cotton yields one-fourth to one-fifth bale per acre in normal years without fertilization. Corn yields 8 to 12 bushels per acre. Peanuts and cowpeas do well, and truck crops, especially watermelons, cantaloupes, and sweet potatoes, give good results. Post oak, blackjack oak, turkey oak (locally called "sand jack"), and hickory are the principal trees on this soil, turkey oak being characteristic of the Norfolk fine sand and sand. This land sells at \$5 to \$15 an acre.

NORFOLK SANDY LOAM.

To a depth of 12 to 16 inches the Norfolk sandy loam consists of a gray to brownish-gray loamy sand or sandy loam, generally the former. This overlies a subsoil of yellow friable sandy clay, which extends to more than 36 inches. The subsoil in the flatter areas may be slightly mottled with gray, especially in the lower part. In many places a layer of yellow loamy sand to sandy loam occurs between the soil and subsoil, ranging in thickness from 3 to 6 inches.

The Norfolk sandy loam is an unimportant soil in Freestone County. It occurs in small areas in the sandy region north and west of Teague, and is associated with the other Norfolk types and the Bowie and Ruston fine sandy loams, small areas of which are necessarily included in the type as mapped.

In some areas the type is nearly flat, while in others it is undulating or gently rolling. Largely on account of the friable nature of the subsoil, the drainage is good or even excessive. The subsoil retains moisture well, however, and with proper cultivation the type is almost as drought resistant as the fine sandy loam of the same series. It is less productive than the fine sandy loam, however, and most of its area remains forested, post oak, blackjack oak, and hickory being the principal trees. The type is adapted to practically the same crops as the Norfolk fine sandy loam, and can be improved by the same methods that are suggested for that type.

NORFOLK FINE SANDY LOAM.

To an average depth of 8 to 16 inches the Norfolk fine sandy loam is a gray to brownish-gray or yellowish-gray, loamy fine sand to fine sandy loam. This generally passes into a layer, 2 to 8 inches thick,

of yellow fine sandy loam to loamy fine sand which in turn gives way at 12 to 20 inches to a subsoil of yellow, friable fine sandy clay, continuing throughout the 3-foot section. The subsoil in places is a fine sandy loam. In the more poorly drained, flat situations it may have fine gray mottlings throughout or at least in the upper part. Such areas represent an approach to the Lufkin fine sandy loam or Scranton fine sandy loam, according to whether the subsoil is stiff or friable. In a few small areas the subsoil is not reached above 24 to 30 inches.

The Norfolk fine sandy loam varies from nearly level to undulating and sometimes rolling. It frequently occupies ridge tops in the rolling country in which the Norfolk fine sand predominates, and slightly elevated areas in regions where types with heavier subsoils predominate, but it is mapped mainly in the regions of friable subsoils.

The type occurs in conjunction with the other Norfolk soils and also with the Ruston and Bowie fine sandy loams. Small areas of the latter are necessarily included with the type as mapped.

Post oak, blackjack oak, hickory, and some elm and bur oak comprise the principal forest growth on this soil in the western part of the county. In the eastern part large numbers of the other species common to the upland are seen. Probably 50 to 60 per cent of the type is still in forest.

On account of the surface relief and the friable nature of the subsoil, the Norfolk fine sandy loam is well drained, and in places the drainage is excessive. The subsoil is naturally retentive, however, and subsurface moisture is readily available for the use of crops by reason of the high capillarity of the fine sandy clay subsoil. Where a surface mulch is maintained the type holds moisture as long as any upland soil in the county, with the possible exception of the Bowie fine sandy loam. It is easily cultivated and generally warms up fairly early in the spring.

Cotton, corn, and peanuts are the principal crops. Cotton ordinarily yields one-fourth to three-eighths bale per acre, and yields of one-half to three-fourths bale are sometimes obtained. Fields which have been cropped for some time are generally fertilized for cotton, 100 to 200 pounds being used per acre. During the present season (1918) the only fertilizer obtainable is a 10-16.5-0 preparation. A home mixture of cottonseed meal and acid phosphate is used by some farmers for cotton. Corn yields from 8 to 20 bushels per acre, depending on seasonal conditions. Peanuts do well on this soil; the plants are full of well-developed nuts and the vines are strong and thrifty. The vines when baled yield three-fourths ton to 1½ tons of hay per acre. Cowpeas also give good results on this soil, either alone or in combination with corn. Winter oats are said to produce

well, but no thrashing is done in the forested section of the county. The oats when harvested are fed in the sheaf. The type is well adapted to watermelons and cantaloupes, and sweet potatoes also do well. These special crops, however, are only grown to supply the local markets. Peaches do well where the subsoil does not lie too far below the surface. Pecan trees seem to thrive, as do also pear trees and grapevines.

Best results on this soil are possible only with a good crop rotation, which should include a legume, to add nitrogen to the soil. Organic matter should be returned to the surface soil either by the addition of stable manures or the plowing under of green crops or litter. This practice would also tend to prevent drifting, to which the soil is subject in the less loamy areas.

Land of this type ranges in selling price from \$10 to \$25 or more an acre.

WILSON SILT LOAM.

The Wilson silt loam, to an average depth of 8 to 10 inches, consists of a dark-brown to black silt loam overlying a black or occasionally dark-brown, stiff, tough clay, which is highly impervious and plastic and sticky when wet. This clay may continue throughout the 3-foot section or may grade below 24 inches into a gray, drab, or yellowish heavy clay of similar structure. The typical subsoil is not calcareous, but in a few small areas the lower subsoil consists of yellow to olive-colored material such as underlies the Crockett soils, containing small lime concretions and effervescent with hydrochloric acid. In a few small areas the upper subsoil is mottled to different depths with red and gray. Light mottling of yellowish or rusty brown is nearly always present in the typical subsoil. As mapped, a few small areas are included with the type in which the soil is a loam and a few others in which the surface soil is a clay.

The Wilson silt loam is mapped in the prairie region of the county, mainly in the vicinity of Wortham. Its total extent is small. It occupies flats and depressions in the Crockett soils or near stream heads and poorly drained strips along their courses. The drainage is naturally poor and must be supplemented by tile drains and open ditches for best results.

The type originally supported a sparse growth of mesquite, and it is locally termed "hardpan flats" or "mesquite flats." If cultivated when dry the soil crumbles fairly readily, but it puddles and forms intractable clods if stirred when wet. In its natural state, or where it is uncultivated for some time the soil is hard and compact. In the depressed areas water stands for long periods after rains.

Cotton and corn are the chief crops on this soil, since grain crops are inclined to grow rank and lode. Cotton yields from one-fourth

to three-eighths bale per acre in normal seasons, and corn from 15 to 25 bushels.

The following table gives the results of mechanical analyses of samples of the soil and subsoil of the Wilson silt loam:

Mechanical analyses of Wilson silt loam.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.
445211.....	Soil.....	0.4	0.8	0.7	7.1	12.8	52.8	25.2
445212.....	Subsoil.....	.3	1.4	.4	5.0	5.7	45.0	42.7

CROCKETT FINE SANDY LOAM.

The soil of the typical Crockett fine sandy loam consists of a grayish-brown to brown loamy fine sand to fine sandy loam, averaging 8 to 10 inches in depth. In the better drained situations this generally passes into a layer of yellowish and reddish mottled or brownish fine sandy loam or fine sandy clay, of friable structure, and in the more poorly drained situations into a black or brown loam or clay loam. Where the subsoil is black, the soil would be mapped as Wilson, if of sufficient extent. The typical subsoil consists of a mottled red and drab, or red, yellow, and yellowish-brown, heavy, stiff clay, plastic when wet and almost impervious to moisture. This extends to depths ranging from 20 to 28 inches, where it grades through a greenish or yellowish-green into a greenish-yellow or olive-colored, heavy, stiff clay. The latter contains small lime concretions in the lower portion of the 3-foot section, and generally effervesces with hydrochloric acid. The red color in the upper subsoil is less prominent where the drainage is poorer, being replaced to some extent by dark greenish gray or olive drab.

Knolls in areas of the type frequently have an upper subsoil of red clay, similar to that of the Susquehanna, this grading into the typical Crockett subsoil through a layer of red and yellow or yellowish-brown mottled, or a red and gray mottled, clay. In these situations the red subsoil may be so near the surface as to give a reddish tinge to the soil, as well as a more loamy texture.

Exposures show considerable variation in subsoil color within short distances, grading from the red of the Susquehanna to the greenish-yellow of the Crockett, and the dark greenish gray or drab of the Tabor.

A small acreage of a gravelly variation is included with the Crockett fine sandy loam as mapped. This occurs mainly between Cotton Gin and New Hope. The gravel is found mainly on the sur-

face and in the surface soil, and is of a quartzitic nature. The fragments are rounded, and 1 to $1\frac{1}{2}$ inches in diameter. The gravel seldom occurs in sufficient quantities to interfere with cultivation.

Large concretions of arenaceous limestone, of round or oval shape, are sometimes seen in the deep subsoil and below a depth of 3 feet. They vary from one-half foot to 3 feet or more in diameter.

Between the wooded Susquehanna fine sandy loam and the typical prairie Crockett fine sandy loam there exists a gradational soil which is not separated from the typical Crockett on the map. It may be sparsely or fairly heavily forested, or partly prairie, but is generally the latter. Where it is wooded the growth represents the recent advance of the forest on the prairie. The surface soil of this gradational type is a gray to brownish-gray loamy fine sand to fine sandy loam, 8 to 10 inches deep, passing into a red, heavy clay, which is mottled with dark gray and generally with a small amount of yellow. This grades at about 20 inches into a heavy clay which is mottled with gray or drab and red, and generally contains some gray and olive mottlings also. It gives way gradually to the typical olive-colored lower subsoil of the Crockett. In some places the lower subsoil is slightly mottled with gray or red, or both. Minute lime concretions are generally found in the deep subsoil, which is mainly calcareous. Where the soil of this variation is forested it supports the growth typical of the Susquehanna in the western part of the county.

Included in the Crocket fine sandy loam as mapped are small areas of Crockett loam and Wilson silt loam. Some typical Susquehanna fine sandy loam may be included at the gradation line between the prairie and the forested upland, and along the stream bottoms in the prairie region. In the wooded upland small areas of prairie soil which resemble the Crockett fine sandy loam, except for a noncalcareous subsoil and a lack of lime concretions, are included with the Susquehanna or Tabor series, depending on drainage conditions.

The Crockett fine sandy loam occupies 50 per cent or more of the prairie upland of the county. Roughly, it is confined to the north of a line drawn from Cotton Gin to the upland north of Tehuacana Creek, and north of the Tehuacana bottoms to a point $2\frac{1}{2}$ miles northeast of Streetman, where the prairie belt passes into Navarro County. A few small areas are mapped on the upland "peninsula" which extends into the county between the Richland Creek and Trinity River bottoms near the northernmost point of the county. Generally the type occupies a slightly higher level than the Crockett loam. It ranges from flat to undulating, and includes knolls and ridges with long, gentle slopes. The general topography of the country in which the type occurs is level or only gently undulating. Surface drainage is facilitated by the pervious nature of the surface soil, but is retarded by the plastic, impervious subsoil.

The Crockett fine sandy loam is considered a good, strong soil in the prairie region, and it is estimated that 80 per cent or more of its total area is under cultivation. The native growth on the prairie consists of mesquite, which is found along streams and roadsides.

Crop adaptations on the fine sandy loam are about the same as on the Crockett loam, and about the same yields are obtained. This soil is not so well supplied with organic matter as the loam, and barnyard manures should be added or green manures plowed in. A dry surface mulch should be maintained for conserving moisture, since the type is inclined to be droughty, though it holds moisture somewhat better than the loam of the series. In addition, it has the advantage of being adapted to a wide variety of crops, and a beneficial rotation, preferably including a legume, can be easily arranged.

Land of this type sells at prices ranging from \$35 to \$75 an acre, depending on the location, improvements, and other local conditions.

CROCKETT LOAM.

The soil of the typical Crockett loam is a grayish-brown to brown loam, 6 to 10 inches deep, being slightly shallower on slopes where erosion has been active. The subsoil consists of a heavy, stiff clay, highly impervious and plastic when wet. The upper subsoil is brown, finely mottled with red or mottled reddish and yellowish, and in some places grayish. It passes into yellowish-brown and then into olive-colored or greenish-yellow, tough clay, which below depths of about 28 inches contains small white nodules of lime. The subsoil shows considerable range in color within short distances. Lime concretions are generally found in the lower subsoil, and the lower material, especially the greenish-yellow clay, usually effervesces with hydrochloric acid, showing the presence of calcium carbonate. The upper mottled subsoil is frequently lacking in small areas, the olive-colored material approaching the surface within plow depth. Lime concretions are generally present in such places and the upper subsoil shows the presence of lime. This condition occurs most often in poorly drained situations, though it may be found also on slopes. In some of the better drained situations the red mottling in the upper subsoil is especially pronounced, and occasionally on knolls the upper subsoil is dull red in color. Where this material closely approaches the surface, the soil has a reddish tinge in cultivated areas. Included in the type as mapped are many small areas of Wilson silt loam, occupying depressions or flats in the more level areas of the type. The presence of these areas of Wilson silt loam gives newly plowed fields a spotted brown and black appearance. Concretions of arenaceous limestone, ranging from a few inches to 36 inches in diameter are sometimes found in the lower subsoil or substratum.

In some places the olive-colored subsoil contains small iron concretions, and over small patches ants have brought them to the surface in abundance. The material containing these black concretions does not effervesce with hydrochloric acid.

Some patches, probably marking the location of old prairie-dog holes, show an abundance of lime concretions at the surface.

As mapped the type includes some gravelly areas, indicated by symbol on the soil map. The gravel, which is rounded in shape, is chiefly quartzitic and ranges in diameter from 1 to $1\frac{1}{2}$ inches. It rarely occurs in sufficient abundance to interfere with cultivation, and is limited to the surface and the subsurface soil section.

The Crockett loam is mapped along the northwestern boundary of the county, from Streetman southwestward, in the prairie region. It owes its existence to the weathering of the Wilcox and Midway formations, the latter of which outcrops in this section of the county. The topography varies from flat to undulating. In some places the type occupies slightly elevated knolls with long gentle slopes. The adequacy of the drainage depends to a large extent on the topography, and drainage is only fair or insufficient. Water frequently stands on the surface for considerable periods after rains, especially in the slight depressions and in the "hogwallows" found on the flatter areas.

Probably more than 85 per cent of the type is farmed. It is considered a good strong soil and is easily cleared, it being necessary to remove only the sparse growth of mesquite which is found in some areas. Where the type borders stream bottoms or the forested upland it supports a growth consisting mainly of post oak.

Cotton, the chief crop, gives an average yield of one-third to one-half bale per acre in years of normal moisture distribution. Corn yields 15 to 35 bushels, averaging about 20 bushels. Winter oats generally yield 20 to 40 bushels per acre, averaging about 25 bushels. Wheat growing has been stimulated during the last few years as a result of high prices and war demands. Yields average about 15 bushels per acre and range from 10 to 22 bushels. Sorghum is occasionally grown. Where it is grown for seed it is reported to yield about 25 bushels per acre. The amber variety is produced for sirup, and 80 to 100 gallons per acre are obtained. A small acreage is devoted to milo and kafir.

Owing to the highly impervious nature of the subsoil this type is inclined to be droughty. It is the first of the important soils of the county to be affected by drought, and when the dry weather is prolonged yields of cotton and corn are curtailed considerably. It is necessary to conserve all the available moisture, and the maintenance of a dust mulch is necessary for best results. In the flatter regions, where drainage is poor, cultivation is delayed until late in the season.

This handicap could be largely removed by the use of open ditches and tile drains. The Crockett loam generally is fairly well supplied with organic matter, and fertilizers are seldom used, except on cotton fields where clean-cultivated crops have been grown for long periods.

The range of crops to which the Crockett loam is adapted makes it possible to rotate crops without loss, and a good rotation should be adopted, preferably including a leguminous crop, such as cowpeas, in corn or following oats or wheat, to add nitrogen to the soil through the root nodules.

The selling price of land of this type ranges from \$35 to \$75 an acre.

SUMTER CLAY LOAM.

The Sumter clay loam has a surface soil of 4 to 8 inches of brown clay to clay loam, stiff and compact in structure, passing quite abruptly into yellowish-brown or brownish-yellow clay, which is stiff in structure and becomes very plastic when wet. This generally extends to more than 3 feet without change. In places, however, it passes into an olive-colored stiff, heavy clay before the 3-foot section is passed. Gray mottling is present in the subsoil in places, and occasionally it is sufficiently pronounced to impart a distinctly grayish cast. When exposed to weathering the subsoil assumes a brown, drab, and even reddish cast in places. When dry, both soil and subsoil crumble readily, in spite of their heavy texture. Lime nodules and silicious lime concretions are generally present at depths ranging from 1 to 3 feet, and in some places they occur on the surface. Huge concretions, varying in diameter from one-half foot to 3 feet or more, are frequently seen in the deep subsoil and substructure.

The Sumter clay loam is of minor importance in Freestone County, its total extent being small. It is mapped chiefly in the prairie region of the county on slopes leading from the upland to the stream bottoms, but it also occupies a number of flat areas. In the eastern part of the county it is mapped in the forested areas leading from the upland to the alluvial bottoms of the Trinity River, the largest of these areas being situated about $1\frac{1}{2}$ miles southwest of Goode Ferry.

In the prairie the type is associated with the Crockett series except on the flats, where it is closely associated with the Wilson. In the wooded areas it is mapped contiguous to the Ruston fine sandy loam.

The type in most places supports a growth of stunted elm, red haw, and mesquite, with occasional post oak. Very little of it is devoted to agriculture.

HOUSTON CLAY LOAM.

The soil of the Houston clay loam consists of a dark ashly brown clay loam to fine sandy loam, averaging about 6 inches in depth. This is underlain by a heavy, stiff, compact, plastic clay, of grayish-yellow, yellowish-brown, or pale-yellow color, filled with whitish lime nodules. The nodules increase in quantity with depth, and in some places constitute about 50 per cent of the lower subsoil. In places on the gentler slopes the surface soil has been removed, bringing the lighter colored material near enough to the surface to give a light-gray color to the type, and making the surface soil a heavy clay loam to clay.

Only about one square mile of this type is mapped in Freestone County. It occurs on the level or gently rolling prairie peninsula extending into the county at its northernmost point, between the Richland Creek and Trinity River bottoms. The type has comparatively good drainage, and retains moisture well.

Cotton, corn, and grain do well on this soil. Cotton, the principal crop, yields one-half to three-fourths bale per acre in seasons of well-distributed moisture. Corn yields 25 to 35 bushels. Grasses and sorghums give good yields of hay, and cowpeas and other leguminous crops do well. Irish potatoes are grown on a small scale, with good results. It is possible to grow alfalfa profitably on this type, owing to its calcareous nature, but the yields are not as high as on the adjoining Trinity clay.

Owing to the remoteness of the areas of Houston clay loam from the railroad, the land is valued at about \$40 an acre.

The following table gives the results of mechanical analyses of samples of the soil and subsoil of the Houston clay loam:

Mechanical analyses of Houston clay loam.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.
445245.....	Soil.....	0.4	1.1	1.0	21.1	19.8	38.1	20.1
445246.....	Subsoil.....	1.4	2.4	1.0	8.7	15.7	35.3	35.6

KALMIA FINE SANDY LOAM.

The Kalmia fine sandy loam consists of a light grayish brown fine sandy loam, underlain at 4 to 6 inches by a pale-yellow loamy fine sand to fine sandy loam, which grades into a yellow, friable fine sandy clay. In poorly drained areas the subsoil is usually mottled with gray, while in some places on the higher and better drained areas the lower subsoil is reddish yellow.

This type is of small extent. The largest area is mapped 2 miles west of Cook Ferry. The type occupies terrace areas along the Trinity River and some of the larger creeks of the county. Its topography is level, but drainage is adequate, owing to the friable nature of the subsoil.

Cotton, corn, oats, and hay are the chief crops on this soil. Cotton yields one-fourth to one-third bale per acre and corn 8 to 12 bushels. Cowpeas, peanuts, sweet potatoes, and grasses do well. The type is much in need of organic matter, which should be supplied by adding barnyard manures, where available, or by turning under green crops.

CAHABA FINE SANDY LOAM.

The soil of the Cahaba fine sandy loam is grayish-brown or brown fine sand to fine sandy loam, extending to a depth of 10 to 15 inches. It changes abruptly into a subsoil of red loamy clay mottled with yellow and gray. This loamy clay contains some fine sand. The red loamy clay subsoil extends to a depth of more than 3 feet in the better drained or typical areas, but in the flat areas, where drainage is not so good, the upper subsoil is a plastic clay mottled red, yellow, and gray. The red becomes less prominent with depth, and in these flat areas the lower subsoil is a gray, heavy clay, mottled with yellow and occasionally with red. These poorly drained areas would have been mapped as Leaf fine sandy loam had they been of sufficient extent.

The Cahaba fine sandy loam occupies rather small, isolated areas on the low terraces along the Trinity River. The largest bodies are mapped at Evans Lake, West Point Hill, and Gilbert Lake. It ranges from nearly level to slightly undulating, and drainage is fair to good.

The greater part of the type is under cultivation. Cotton and corn are the principal crops, followed by cowpeas, peanuts, and native grasses. Cotton yields one-fourth to three-fourths bale per acre, and corn from 10 to 20 bushels. The soil is well suited to potatoes and truck crops, but their production is limited by the inaccessibility of markets.

The type is much in need of organic matter which can best be supplied by growing cowpeas, velvet beans, or other legumes.

Land of this type is valued at \$20 to \$25 an acre.

Some areas of Cahaba fine sand are included with the Cahaba fine sandy loam on the map. They consist of 3 feet or more of brown fine sand or loamy fine sand, with no noticeable change in color or texture from the surface downward, save in a few places where the lower subsoil becomes slightly lighter. The Cahaba fine sand occurs in small areas on the Trinity River terrace, the largest body lying

immediately to the south of Gilbert Lake. The surface is level or billowy. Drainage is adequate as a result of the slight surface relief and the open, porous nature of the soil. The type retains moisture well, but it is inclined to be droughty during long dry seasons. It is used principally for peanuts, cowpeas, and sorghum for forage. Corn and grasses are grown to some extent. The yields of peanuts and cowpeas are good, but corn yields only 8 to 12 bushels per acre under the present farming methods. The type is easily cultivated, has good circulation of air and moisture, and is fairly retentive of fertilizers. It is adapted to a wide range of crops, but could not be profitably used for trucking at present owing to the distance from markets.

LEAF FINE SANDY LOAM.

The Leaf fine sandy loam consists of 4 to 6 inches of grayish-brown fine sandy loam, which passes into pale-yellow or yellowish-gray fine sandy loam. The subsoil, beginning at 8 to 10 inches, is stiff, plastic clay, ranging in color from bright red to dark red or yellow, and mottled below a depth of 15 to 20 inches with gray, red, and yellow. The gray color usually predominates at the lower depths. The deep-red coloring in the subsoil is confined to the better drained situations, while the more poorly drained areas have a lighter colored subsoil, with more intense mottlings. The type is the terrace equivalent of the Susquehanna fine sandy loam of the upland.

The Leaf fine sandy loam occurs on the terraces of the Trinity River to the northeast of Oakwood, and has a level to gently sloping surface. It is fairly well drained, being dissected by numerous short, intermittent branches.

The greater part of this type is forested and used for pasture. It supports a growth of oak, hickory, and other hardwoods. It is fairly well suited to the production of cotton, corn, peanuts, sorghum, and grasses, but yields are subject to considerable fluctuation from year to year with variations in the rainfall distribution. In wet years the yields of cotton are poor, while in dry seasons corn suffers. The plowing under of cowpeas or other legumes would make this soil more productive. It has a selling value at present of \$15 to \$25 an acre.

MYATT VERY FINE SANDY LOAM.

The surface soil of the Myatt very fine sandy loam consists of 6 to 8 inches of gray to dark-gray very fine sandy loam, grading into ashy-gray very fine sandy loam. This in turn gives way to a dark-gray, heavy clay, containing rusty-brown iron stains. The stains become more prominent in the lower part of the 3-foot section. There is generally a rather sharp transition from the surface material to the clay of the subsoil.

A few small areas in which the surface material is a silt loam or silty clay loam are included in the type as mapped. The soil is very light gray or ashy gray, and the subsoil is a light-gray, heavy, sticky, plastic clay, with faint mottlings of brown. These included soils occur in depressions, where water remains for long periods after rains.

The Myatt very fine sandy loam is confined to the terraces of the Trinity River and is of very small extent. Its chief occurrence is northeast of Oakwood and south of Gilbert Lake.

The surface is flat except for a few minor depressions. In the winter and in periods of heavy rainfall the surface is frequently covered with water, or at least the soil may be so saturated that it is unsafe to attempt to cross the surface with heavily laden vehicles. During the summer, however, the soil is dry and firm. The range of moisture conditions under which the type can be cultivated is restricted to some extent, but it can be tilled much sooner than the clay member of the series following rains. The greater part of the type would present little difficulty in cultivation.

The larger proportion of the Myatt very fine sandy loam remains forested. The growth consists almost entirely of post oak, but there is some hickory and elm. The principal crops grown are cotton and corn. Average yields for the type as a whole are probably a little less than one-half bale of cotton and 10 or 15 bushels of corn per acre. In favorable seasons some of the more carefully cultivated fields have produced 1 bale of cotton or 20 to 25 bushels of corn per acre. Both cotton and corn suffer from drought in some years. Sorghum for forage gives fairly good results.

It is probable that the use of commercial fertilizers would be profitable on this type. The incorporation of organic matter in the surface has proved highly beneficial. The growing of cowpeas is an excellent means of enriching the soil, and they can be grown successfully where the land is properly prepared.

Cultivated areas of this type are valued at \$25 to \$40 an acre, and uncleared land at \$15 to \$25 an acre.

MYATT CLAY LOAM.

The Myatt clay loam has a thin surface covering of gray to grayish-brown very fine sandy loam, underlain by dark-gray clay, slightly mottled with dull yellow or brown, extending throughout the 3-foot section. In some places, as on Highland Ridge, there is some dull-reddish mottling at a depth of 8 to 15 inches. The friable surface covering is only 2 to 5 inches deep, and the heavy clay is turned up in plowing, resulting in a soil having a clay loam texture.

The Myatt clay loam occupies low terraces along the Trinity River and Tehuacana and Richland Creeks. It is of very small ex-

tent. The largest area lies to the south of Tylers Ferry. The type has a flat to nearly level surface, and is poorly drained. The greater part of it supports a growth of oak and other hardwoods.

Cotton and corn, with some sorghum, are the principal crops grown. Cotton in favorable years yields one-half to three-fourths bale per acre, and corn from 25 to 30 bushels. Where artificial drainage is possible this could be made a valuable agricultural soil. The land at present sells for \$15 to \$25 an acre.

Some small areas of Myatt clay are included with the Myatt clay loam in mapping. They occur chiefly northeast of Oakwood, along the International & Great Northern Railroad. The Myatt clay consists of a gray, heavy, stiff clay, containing some dark-brown iron stains and iron concretions, underlain at about 6 inches by a subsoil of gray, stiff, heavy clay slightly mottled with yellow. The type is of small extent and unimportant. It is found on the terraces of the Trinity River. The surface is flat to very gently undulating, and drainage is poor. Part of the type is under cultivation to cotton and corn. In years of well-distributed rainfall good yields are obtained, but average yields under present methods of cultivation are somewhat lower than on the Myatt very fine sandy loam. Deeper plowing and the incorporation of manure or other forms of organic matter are the most effective means of increasing the productiveness. Deep plowing is very difficult on account of the tough, compact nature of the clay subsoil. Cultivation is impracticable when the soil is wet. Land of this type is valued at \$20 to \$25 an acre.

TRINITY CLAY.

The typical Trinity clay consists of a dark-brown to black clay, of compact structure and waxy nature, passing quickly into black or even jet-black, waxy, heavy clay, which generally contains some brown or rusty-brown mottlings throughout or at least in the lower portion. In some places the subsoil below 24 inches is a brown or dark-brown, heavy clay, and in others a grayish, heavy clay, sometimes slightly sandy. Where the type adjoins the upland or the sandy terraces the surface soil is frequently a brown clay loam, the coarser texture being due to the addition of colluvial material. The typical soil on drying assumes an ashy-gray or dark ashy gray color.

The Trinity clay is developed in the first bottoms of the Trinity River and extends for some distance back along the larger streams which enter the bottoms from the upland, the material here having been deposited by backwater from the river. The soil material has been derived from the black, waxy upland belt to the northward and northwestward. The type is still subject to overflow during high water, and sediments are added in some places and removed in others during these overflows.

A flat or nearly flat surface is characteristic of the Trinity clay, with a slight slope toward the streams and in the direction of the current. The natural drainage is poor or only fair, and ditching, to insure the removal of rain and flood waters, is necessary before the type can be farmed. A number of depressions within the areas of the Trinity clay hold water the greater part, if not all, of the year, and are locally termed lakes.

In most places the soil is calcareous from the surface downward, but this is not the case near the upland edge, where the material is somewhat older and has been influenced to some extent by the addition of colluvial material. Minute lime nodules are frequently seen in the deep subsoil, and in a few instances they occur in the soil. The heavy, waxy nature of the soil does not retard cultivation as much as might be expected, since the soil flocculates on drying and assumes the desirable crumbly structure common to soils with a good lime content. Even in places where the soil does not effervesce with hydrochloric acid, it crumbles on drying. The organic supply in the surface soil is also good and aids in maintaining a desirable tilth.

Despite its high productiveness, only a small proportion of the Trinity clay is cultivated, crops being confined to the higher lying areas which are less liable to overflows. The remainder of the type is heavily forested with the hardwoods common to the county, water oak, pin oak, elm, hackberry, red haw, and ash being particularly prominent. In places there is considerable honey locust, smilax ("bamboo"), and swamp palmetto. The productiveness of the type warrants the development of a levee system to make intensive agriculture safe. Under present conditions the type is used mainly for pasture.

Cotton and corn are the leading crops. Cotton ordinarily yields one-half to three-fourths bale per acre, and corn 20 to 40 bushels, and yields of 1 bale of cotton and 50 bushels of corn are occasionally reported. A small acreage is devoted to alfalfa, which seems to do well. Three or four cuttings per year are obtained, averaging three-fourths ton or more per acre, and if the type were protected from overflow the production of alfalfa should prove very profitable. Small grains are inclined to grow rank and lodge on this soil.

Land values on the Trinity clay range from \$8 to \$40 an acre, depending largely on the location.

Trinity clay, terrace phase.—Some small bodies of a dark-gray to dark brownish gray clay loam to clay, with a pale-yellow or drab, moderately heavy clay subsoil containing lime nodules, are shown as a terrace phase of the Trinity clay. They occupy low terraces. Their total area is less than one square mile, the largest body being that $2\frac{1}{2}$ miles southeast of Goetz. The surface is nearly level, and the drainage is generally poor, though adequate in places. Originally

this soil supported a vigorous growth of oak, hickory, and other hardwoods. Most of it is at present under cultivation, used principally for cotton and corn. Cotton yields one-half to 1 bale per acre and corn from 25 to 40 bushels, in seasons of well-distributed rainfall. Sorghums and the native grasses give good returns. This land is valued at \$25 to \$40 an acre.

OCHLOCKONEE FINE SANDY LOAM.

The surface soil of the typical Ochlockonee fine sandy loam is a grayish-brown to brown fine sandy loam, averaging 8 to 10 inches in depth. The subsoil is a yellowish to gray or brownish-gray clay loam to clay, generally mottled with rusty brown or yellowish brown, and containing iron concretions and accretions. The subsoil is generally stiff and compact when dry, and sticky and plastic when wet.

There is considerable variation in the type in this county. The soil in places ranges to a very fine sandy loam in texture. In some areas a layer of gray silt, very fine sand, or very fine sandy loam, 3 or 4 inches thick, occurs between the soil and subsoil. Also, layers of material ranging in texture from very fine sand to loam and clay, and in color from gray to black, are frequently interstratified in the typical subsoil.

The Ochlockonee fine sandy loam occupies first bottoms along the larger streams, and represents alluvial material deposited during overflow. Along the margin of the bottoms the type is mingled with some colluvial material, brought down by the drainage waters from the upland. The type is subject to periodic overflow, during which the greater part of the surface receives new alluvium. These constant overflows account for the interstratification of material of different textures and colors within the otherwise typical profile. The fine sandy loam occupies a higher position than any of the other Ochlockonee soils. It is typically developed along Tehuacana, Keechi, Browns, Little Brown, Buffalo, Linn, Sanders, and Cottonwood Creeks, as well as a large number of small and unnamed drainage ways. The surface is flat, with only a slight slope toward the channel and in the direction of the flow, and drainage is only fairly well developed.

In the forested areas the principal growth is post oak, swamp white oak, water oak, willow, and ash, with some hickory, walnut, and pecan. In the eastern part of the county gum and bay also are found, and the undergrowth of sumac, bamboo vine, holly, myrtle, and other plants is sometimes very dense. The wooded areas usually have a good growth of Bermuda grass and are used for pasturage.

This is considered a strong, productive soil, and almost all of it except the lowest lying areas is cultivated. It is well adapted to

corn and cotton, which are the chief crops. Corn approaches nearer to cotton in acreage than on any other soil in the county. Depending largely on local conditions, the yield in normal seasons varies from one-fifth to three-fourths bale per acre, and as much as 1 bale per acre is occasionally reported. Corn yields 15 to 35 bushels per acre, 25 bushels probably being a fair seasonal average. Yields of all crops are reduced in droughty years. Peanuts do well when the season is not too wet. Cowpeas make a strong, vigorous growth. Sweet potatoes, watermelons, and other garden crops give good yields, but the "lateness" of the type makes it unsuited for commercial trucking.

Straightening and deepening the stream channels and clearing them of tree trunks and rubbish would make possible the reclamation of a large acreage of this type, which is now subject to overflow to such an extent that agriculture is impracticable. The soil is naturally strong and productive, and fertilization is unnecessary at the present time. The use of tile drains and open ditches would make the soil warm up earlier in the spring, permitting earlier planting and harvesting of all the crops. Areas of the type at present sell for \$15 to \$35 an acre.

OCHLOCKONEE SILT LOAM.

To a depth of 8 to 12 inches the Ochlockonee silt loam is a grayish-brown to brown or dark-brown silt loam, fairly compact in structure in virgin areas, and inclined to be sticky when wet. The subsoil is a dark grayish brown to dark-brown, heavy clay loam to clay. It generally contains mottlings of brown, and these become more intense toward the bottom of the 3-foot section. The type as mapped includes small areas of Ochlockonee fine sandy loam and silty clay loam, with which it is closely associated.

In some places a layer of gray very fine sand to silt occurs between the soil and subsoil. Frequently also thin layers of material ranging in texture from very fine sand to clay are interstratified in the subsoil. Along the edges of the upland colluvial wash from the slopes gives rise to a fine sandy loam texture in many places.

Large areas of Ochlockonee silt loam are mapped along Tehuacana, Buffalo, and Keechi Creeks and other streams. It is subject to periodic overflow, and in addition is flat and poorly drained. The type occupies a position intermediate between the fine sandy loam and the silty clay loam of this series. The proportion of cultivated land is less than in the case of the fine sandy loam, about 50 per cent of the type being farmed. In its virgin condition it is forested with a growth similar to that on the fine sandy loam.

Cotton and corn are practically the only crops grown on the Ochlockonee silt loam. Cotton yields one-fourth to one-half bale

per acre or slightly more in normal seasons. The yield of corn ranges from 15 to 30 bushels per acre.

This is considered a good, productive soil. Its naturally poor drainage, however, causes it to warm up later than the fine sandy loam, and the range of moisture conditions under which it can be cultivated is more restricted. Artificial drainage and the clearing and straightening of the stream channels are necessary for the most efficient development of the type. At present it sells for \$15 to \$35 an acre.

OCHLOCKONEE SILTY CLAY LOAM.

To an average depth of about 6 inches the Ochlockonee silty clay loam consists of a brown or dark-brown silty clay loam, rather compact in structure when dry and plastic and sticky when wet. This passes into a subsoil of brown or dark-brown, stiff silty clay loam to clay, nearly black in places. Brown mottlings are generally present, but occasionally gray mottlings are encountered. Frequently at 24 to 30 inches the subsoil becomes a gray, heavy, stiff, impervious clay, mottled with brown; it becomes very plastic when wet. In such situations the gray mottling in the upper subsoil increases with depth, the change from the brown subsoil into the gray being gradual.

This type occupies first bottoms along the larger streams of the county. Extensive areas are mapped along Cedar, Tehuacana, and Keechi Creeks. Small areas of the other Ochlockonee soils are unavoidably included with the type as mapped. The fine sandy loam and silt loam occupy slight elevations, hummocks, or ridges, while many of the depressions are occupied by the clay of the series. The surface of the silty clay loam is flat, and drainage is poor. The use of tile drains or open ditches is necessary for best results under cultivation. The type can not be worked under a wide range of moisture conditions, and heavy draft animals are necessary for its successful cultivation. Owing to the poor drainage, crops are usually late.

The greater part of the type remains forested, since it is covered by most of the overflows. The same tree growth is encountered as on the Ochlockonee fine sandy loam. There is generally a good growth of Bermuda grass, and in the eastern part of the county cane is found, making the type well adapted to pasturage.

Cotton ordinarily yields one-third to one-half bale per acre, but in some years the top crop does not mature before the first killing frost. Corn yields 15 to 30 bushels per acre in seasons of normal moisture distribution. Crops frequently run to weed on this type, failing to fruit properly.

OCHLOCKONEE CLAY.

The Ochlockonee clay, to a depth of 6 to 8 inches, is a dark-brown silty clay, which passes into a dark-brown, stiff, heavy, impervious

clay to silty clay, generally mottled with gray. This material may extend throughout the 3-foot section or may change at 24 to 30 inches into a dark-gray or bluish clay, mottled with brown. In some places the subsoil is a dark-gray or bluish-gray clay, mottled with brown iron stains. Occasionally it contains interstratified layers of material ranging in texture from sand to clay. The immediate surface material is sometimes a silty clay loam. In any case when dry it generally assumes a gray color and a crumbly structure. When wet, however, both soil and subsoil are extremely sticky and plastic.

The Ochlockonee clay is mapped in first-bottom positions along the larger creeks of the county, fairly extensive areas occurring along Tehuacana Creek. Small areas of the type are necessarily included with other members of the Ochlockonee series. The type occupies the lowest position in the stream bottoms and frequently is found in large, shallow, basin-like depressions. In places it is well dissected by old stream channels and overflow channels. On account of its flat surface, low position and depressions it is frequently covered with water for long periods after overflows or heavy rains. None of the type is under cultivation. In its virgin condition it is forested.

SUMMARY.

Freestone County is situated in east-central Texas. It has an area of 871 square miles, or 557,440 acres.

The upland of the county is part of the Gulf Coastal Plain and is generally a smooth, even plain with a gentle slope from the north and west to the east and south. This plain is well dissected and becomes hilly as the chief drainageways are approached. Several prominent hills are found in the central and eastern parts of the county. All the larger streams are bordered by strips of nearly level flood plains. The elevation of the county ranges from 200 to 600 feet above sea level.

All but about 50 square miles of the county is forested. The prairie section occurs in the western part and connects with the Black and Grand Prairie region of central Texas.

The drainage from the greater part of the county finds its way into Trinity River through several large creeks, some of which originate in Freestone County. A small area in the southwestern part of the county is drained indirectly into the Navasota River, outside the county. All the streams in the county except Trinity River are intermittent.

The Trinity River is bordered by isolated remnants of terrace. The largest terrace area occurs east of Oakwood, extending south from that place for a considerable distance.

Settlement in this county was begun in 1834, but development was delayed because of trouble with the Indians, and active settlement did not begin until 1844. The pioneers came chiefly from the regions to the north and east.

The population of the county in 1920 was 23,264, of which 3,306, or the population of Teague, is classed as urban. Fairfield, the county seat, Wortham, Oakwood, Streetman, Kirvin, Freestone, and Donie are locally important towns.

The western part of the county is well supplied with railway facilities, but these are lacking in the northeastern part. The public highways are chiefly dirt roads, but some permanent highways are planned. The county is well supplied with cotton gins, and schools and churches are conveniently located. Rural telephone lines and mail delivery routes extend to all parts of the county. Houston and Dallas are the chief markets for all the farm products except live stock, which is shipped to Fort Worth.

Freestone County has an average growing season of 244 days. There is a recorded range in temperature from 7° below zero to 113°, with a mean annual temperature of 66° F. The mean annual precipitation as recorded at Palestine is 43.14 inches, and as recorded at Corsicana 35.98 inches.

Cotton is the principal money crop, and corn ranks next in importance. Considerable oats and some wheat are grown. Peanuts are assuming a place of considerable importance in the agriculture. Cowpeas are grown extensively either in corn fields or alone. Sorghum is grown by many farmers, mainly for forage. Irish potatoes, sweet potatoes, watermelons, and cantaloupes are the chief special crops. Peaches are the principal fruit. Cattle raising is a well-developed industry, particularly in the eastern, more rolling portion of the county. Hog raising is an important source of income in the same section. A small number of goats and sheep are raised.

A systematic crop rotation is practiced by few farmers, and only on a small number of farms are progressive methods of cultivation followed. Modern machinery, however, is employed in almost every part of the county. More than 50 per cent of the farms are operated by tenants.

Freestone County lies within the Coastal Plain, and the soil material belongs to the Eocene period of the Tertiary, the formations composing the upland being recognized as the Wilcox and Midway. The upland soils are derived from unconsolidated deposits, chiefly sands and clays. Weathering processes have given rise to considerable soil differences, and the upland soils are classed in the Susquehanna, Tabor, Kirvin, Ruston, Bowie, Norfolk, Lufkin, Wilson, Crockett, Sumter, and Houston series. The alluvial soils occupying terraces or former flood plains are classed in the Kalmia, Cahaba,

Leaf, and Myatt series, while the first-bottom soils fall into the Trinity and Ochlockonee series. The Trinity soils are derived from the black prairie lands through which the Trinity River flows before reaching the county, while the remaining alluvial soils are largely derived from the sandy, local uplands.

Of the forested, heavy-subsoiled types, the Susquehanna fine sandy loam is the most extensive and the most important agriculturally. The Bowie fine sandy loam is probably the best agricultural soil of the forested, friable-subsoil division, while the Norfolk soils rank first in extent. The Crockett fine sandy loam and loam are the chief soils of the prairie region. The terrace soils are of small extent. The Trinity clay is a good, strong soil, and if leveed to prevent inundation would be the best agricultural type in the county. The Ochlockonee fine sandy loam is the most important of the first-bottom types agriculturally.



[PUBLIC RESOLUTION—No. 9.]

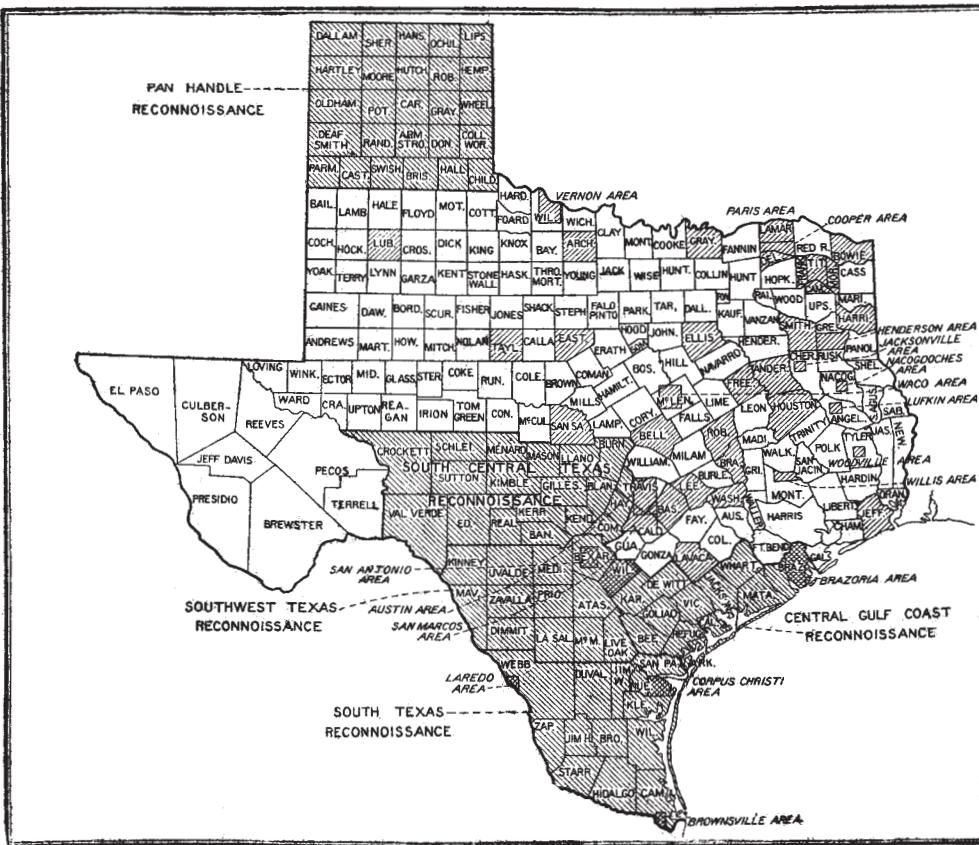
JOINT RESOLUTION Amending public resolution numbered eight, Fifty-sixth Congress, second session, approved February twenty-third, nineteen hundred and one, "providing for the printing annually of the report on field operations of the Division of Soils, Department of Agriculture."

Resolved by the Senate and House of Representatives of the United States of America in Congress assembled, That public resolution numbered eight, Fifty-sixth Congress, second session, approved February twenty-third, nineteen hundred and one, be amended by striking out all after the resolving clause and inserting in lieu thereof the following:

That there shall be printed ten thousand five hundred copies of the report on field operations of the Division of Soils, Department of Agriculture, of which one thousand five hundred copies shall be for the use of the Senate, three thousand copies for the use of the House of Representatives, and six thousand copies for the use of the Department of Agriculture: *Provided*, That in addition to the number of copies above provided for there shall be printed, as soon as the manuscript can be prepared, with the necessary maps and illustrations to accompany it, a report on each area surveyed, in the form of advance sheets, bound in paper covers, of which five hundred copies shall be for the use of each Senator from the State, two thousand copies for the use of each Representative for the congressional district or districts in which the survey is made, and one thousand copies for the use of the Department of Agriculture.

Approved, March 14, 1904.

[On July 1, 1901, the Division of Soils was reorganized as the Bureau of Soils.]



Areas surveyed in Texas.

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